EXTENSION OF SUBWAY
AND
RAPID TRANSIT IMPROVEMENTS
BOYLSTON STATION
TO
FOREST HILLS
PRELIMINARY REPORT

PRAEGER - MAGUIRE
AND
SINGSTAD & BAILLIE
ENGINEERS
BOSTON, MASS.

PRAEGER-MAGUIRE
AND
SINGSTAD & BAILLIE
ENGINEERS
294 WASHINGTON STREET
BOSTON 8, MASSACHUSETTS

July 24, 1952

Mr. Edward Dana, General Manager
Metropolitan Transit Authority
Park Square Building
Boston 16, Massachusetts

EXTENSION OF SUBWAY
AND
RAPID TRANSIT IMPROVEMENTS
BOYLSTON STATION
TO
FOREST HILLS

PRELIMINARY REPORT

Dear Sir:

In conformance with your request to prepare preliminary designs for the construction of a subway and rapid transit system from the existing Boylston Street Subway to the existing Forest Hills Station in the City of Boston, we hereby respectfully submit our report covering the preliminary phase of the work.

This phase of our contract requires that we:

A. Review Boston Redevelopment Authority 8-11-64 Metropolitan Transit Authority and others.

B. Conduct subsurface investigations of the soil throughout the entire site, and

C. Prepare preliminary designs, plans, and cost estimates.

Prior to and after receipt of our contract we examined the entire area involved in the proposed project in the field, studied the drawings of layouts which had been made by others and discussed the details of the project with your engineers.

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Re: Extension of Subway and Rapid Transit Improvements - Boylston Station to Forest Hills

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Prior to and after receipt of our contract we examined the entire area involved in the proposed project in the field, studied the drawings of layouts which had been made by others and discussed the details of the project with your engineers.

An instrument survey was made of the entire length of the project. A contract was awarded for borings which was supervised by our engineers. Undisturbed soil samples were obtained and have been analysed in a soils laboratory.

A survey of adjacent buildings and of all subsurface utilities was made and the results plotted on drawings.

We have prepared preliminary designs, plans, specifications and estimates of cost. Some three hundred drawings which are the result of our investigations and designs accompany this report.

Attached to our drawings are prints of drawings of the track work, signal system, power and lighting facilities which were prepared by the Engineering Department of the Metropolitan Transit Authority.

Our studies and designs are based on the "Legislative Route" as indicated on the 1" = 400' scale drawing prepared by the Metropolitan Transit Authority, dated March 15, 1948. In addition, we have made designs, drawings and estimates of an alternate route at and adjacent to the Dudley Street Station and the results of this study are included in this report.

During the course of our work it has been necessary to confer at frequent intervals with members of your Engineering Department, and in order to arrive at a solution which is satisfactory to both your engineers and to ourselves, numerous changes and revisions to our original design have been made.

In certain locations difficult engineering problems were encountered, as for examples, (a) the section adjacent to the N. Y.,

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N. H. & H. R. R. embankment where the right of way lies above the Stony Brook culvert, (b) the construction at Dudley Street, and (c) the crossing under the combined right of ways of the New York, New Haven and Hartford and the Boston and Albany Railroads at Washington Street.

At the latter location we prepared two designs, one based on the open cut method of construction and an alternate scheme based on a shield driven tunnel. Meetings were held with representatives of the Engineering Departments of both railroads, and we have approvals of both companies to construct this section under their right of ways by either the tunnel or the open cut method. Agreements have also been reached with the N. Y., N. H. & H. R. R. in connection with the construction of the embankment section adjacent to the Railroad right of way.

The underground section otherwise presented no unusual problems. Designs of reinforced concrete and structural steel with concrete jack arches were made both at and between stations. The reinforced concrete design proved more economical between stations whereas the steel and jack arch scheme proved to be more advantageous at stations.

Difficult problems involving maintenance of traffic were encountered at the Boylston Street and Forest Hills connections and also at Dudley Street. At the latter site not only rapid transit operations must be maintained but heavy surface vehicular and pedestrian traffic must be coped with.

We have endeavoured in all cases to use a minimum of critical materials without jeopardizing the quality of the construction.

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We have endeavoured in all cases to use a minimum of critical materials without jeopardizing the quality of the construction.

The preparation of cost estimates presents a problem in this period of relative instability of the construction industry. Our estimates, however, reflect our best judgment, confirmed by prices of contemporary construction, of the cost of the work included in our contract. The total cost of the Legislative Route has been estimated to be $35,000,000, and that of the Alternate Route $33,000,000.

Either route will function satisfactorily, but it is our opinion that the Alternate Route is the better solution from design, construction, operation and maintenance viewpoints and will better serve the traveling public.

The estimates of cost include in addition to construction of the new work and demolition of the existing elevated structure, the costs of track work, signal system, power, lighting, station equipment, contractor's overhead and profit, real estate condemnation costs, demolition, engineering, legal and administrative costs, contingencies and interest on funds required during construction.

We believe that a satisfactory solution of the problems encountered in this study has been developed. We desire to express our appreciation of the opportunity afforded to participate in this study, and to acknowledge the helpful cooperation rendered to our firms by your Engineering Department.

With the submission of this report we are of the opinion that we have complied with the requirements of the preliminary phase of our contract. It is requested that the details of our report be given such study as you may desire. Any corrections or changes

which you may consider necessary will be given our prompt attention.

Respectfully submitted,

Praeger-Maguire
and
Singstad & Baillie

By: Ed Praeger

Charles A. Maguire

Ole Singstad

David G. Baillie Jr.

Respectfully submitted,

Praeger-Maguire
and
Singstad & Bailie

By: _____

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BOYLSTON STATION TO FOREST HILLS

Preliminary Report

Description of Project

The project covered by this preliminary report involves the provision for a new rapid transit facility to replace the existing elevated railroad structure between the Boylston Street station at the northerly extremity near La Grange Street and Brookley Road adjacent to the Forest Hills Station at the southerly limit. The elevated structure was constructed some forty-seven years ago and accommodates two tracks. The present structure extends through Washington Street and, as in the case of most such overhead railroad facilities, has resulted in retarding the development and improvement of the adjacent properties with consequent loss of adequate tax returns to the City. In addition to being an eyesore it is a nuisance because of resultant noise and dirt.

The new construction is to consist of an underground structure from the existing subway at the north extending through Washington Street and Shawmut Avenue to Columbus Avenue, a

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Preliminary Report

Description of Project

distance of 15,390 feet, where a transition of 690 feet will occur and the structure will extend above grade on an embankment parallel with and adjacent to that of the New York, New Haven and Hartford Railroad right of way 5640 feet to a point about 100 feet north of Williams Street. At this location the construction will return to Washington Street on an elevated structure 1070 feet long joining the existing elevated structure at Brookley Road adjacent to the Forest Hills Station.

Present and Future Methods of Operation

The elevated structure which is to be replaced by the new construction consists of two tracks which provide two way rapid transit operation between the Boylston Station and Forest Hills Station with stations at Dover, Northampton, Dudley, Egleston and Green St., terminating at the Forest Hills Station.

Two track operation will be provided in the new facility and stations and traffic interchanges will be provided at corresponding locations to those of the present line.

Details of the Project

(A) The Railroad Undercrossing

Near the start of the project at the north a somewhat difficult construction problem is encountered in the crossing of the subway under the tracks of the New York, New Haven and Hartford and the Boston and Albany Railroads. The originally proposed alignment has been shifted slightly to the west at this location to avoid crossing

under the two structures which carry the street traffic and the present Washington Street Elevated structure over the depressed railroad right of way. Nevertheless, it will be necessary to lower the new structure so that the track elevation is about 39 feet below the street surface and 23 feet below the track elevation of the railroads. The relatively low ground elevation and the necessity of performing the construction without unduly interfering with heavy main line railroad operations result in difficult construction operations.

Performing the above operation by the shield tunnel method would obviate interference with railroad operations and designs and drawings have been prepared for constructing this section by that method. However, the section is relatively short (705 feet of twin tube construction of which 115 feet is under the railroad right of way) and almost as much costly compressed air and other tunneling equipment would be required as would serve for a tunnel of much greater length.

The shield tunnel method for this crossing contemplates two cast iron lined tubes, adequately caulked for watertightness, and lined with concrete. One shield will be used for driving the tubes, one tube to be driven from a shield chamber to be constructed at Broadway, the northerly limit of the tunnel to Cobb Street, the southerly limit of the tunnel, where the shield will be reversed and the second tube driven north to Broadway. The shield tunnel method requires the lowering of the subway track a maximum of about 5 feet below that required by the open cut method in order to provide sufficient cover over the tops of the tunnels at the railroad crossing. The shield tunnel design includes a

sump and pump chamber at the low point of the crossing under the railroad.

Designs have also been prepared for constructing this section by the open cut method using a scheme similar to one which was successfully carried out during the construction of a subway section under the tracks and right of way of the Boston and Albany Railroad at Huntington Avenue several years ago.

Drawings of suggested methods of open cut and tunnel construction were submitted to both railroads and after detailed study both methods were approved. A drawing of a scheme of the open cut method, prepared by the New York Central Railroad (owning company of the Boston and Albany) and approved by the New York, New Haven and Hartford Railroad has been incorporated in our report drawings. This scheme differs slightly in detail from a scheme submitted to the railroads by our office.

(B)Typical Underground Section

After passing the undercrossing of the Railroads the new facility will be constructed by the open cut method. The line swings from Washington Street to the west and reaches Shawmut Avenue at Dover Street. This short section extends between streets and under buildings which must be underpinned. From Dover Street the subway extends through Shawmut Avenue to Woodbury Street where the line swings east through private property to reach the Dudley Street Station. The line then swings back to Washington Street through which it extends to Valentine Street and thence to the portal east of Columbus

road.

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(3) Tunnel Construction

After passing the undercrossing of the Railroads the new facility will be constructed by the open cut method. The line swings from Washington Street in the west and crosses Harrison Avenue at Dover Street. This street section contains many buildings which must be underpinned. From Dover Street the subway extends through Shawmut Avenue to Northampton Street the line swings east through private property to reach the Albany Street station. The line then swings back to Washington Street through which it extends to Waltham Street and thence to the portal east of Columbus

Avenue. There are to be underground stations at Union Park Street, Massachusetts Avenue and Dudley Street.

The street will be decked over during construction, permitting continuance of street traffic with occasional temporary detours during isolated construction operations. Residents along the route will be inconvenienced and traffic reduced at times, but the character of Shawmut Avenue and other streets affected and the part which these streets now play in the overall pattern of city traffic is such that relatively little inconvenience will be experienced. In consideration of the magnitude of the project and the ultimate benefit which will result, some inconvenience must be tolerated.

Many designs and estimates were prepared to determine the best and most economical solution of the underground problem. Economy in the use of critical materials (particularly structural steel) were given consideration and other materials substituted wherever possible without sacrifice of quality. For the relatively long repetitive sections between stations, reinforced concrete rigid frame construction was found to be most desirable and this type of design has been used under streets. A combined steel and concrete section was adopted under buildings. At the stations structural steel members with concrete jack arches spanning between wall columns and roof beams proved to be the more desirable method. Except at crossovers, where the roof spans between the exterior walls, there are supporting members between the northbound and southbound tracks.

The floor of the subway between stations is of reinforced concrete while structural steel and concrete inverts were used in stations. The mezzanine floors are of concrete and structural steel construction. The details of design of the underground construction varies with the depth, nature of soil, ground water level and other conditions.

The floor, walls and roof are to be waterproofed throughout the entire length.

(C) Ventilation

Provision for ventilating the entire underground section of this project has been made in accordance with the best modern practice.

The method of ventilation to be used is based on the piston action of moving trains pushing or drawing air through openings in the subway walls or in the subway roof from connecting flues terminating in gratings located in the sidewalk adjacent to the curb. Seven (7) emergency fan chambers have been provided at intervals along the subway structure, each fan chamber containing two axial flow fans. The system is designed for four (4) complete changes of air per hour and will only be used in cases of emergency.

(D) Station Treatment

The three underground stations, Union Park Street, Massachusetts Avenue and Dudley Street, are of similar general design. Two side platforms have been provided in each case and the stairways and space for escalators have been located outside of the neat lines of the platforms. Columns have been

placed on fifteen foot centers longitudinally and located five feet inside the edge of the platforms.

Provision has been made for turnstiles, change booths, toilets and other facilities. In all stations except the Dudley Street Station (Alternate Route) where long passageways are provided, a mezzanine about 100 feet in length extends over both platforms and tracks. A minimum vertical clearance of eight feet six inches has been provided over mezzanine floors and ten feet eight inches over station platforms. Vertical and horizontal clearances, both at and between stations, have been provided to meet the requirements of safe railroad operation with present and foreseeable future equipment. Minimum radii of curvature, vertical grade and other details are also in accordance with safe rapid transit operations.

A bench over the duct bank at both sidewalls provides an emergency walk and niches have been provided for track workers in the center walls. At the Union Park Street and Massachusetts Avenue stations provision has been made for escalators from the mezzanine to the street. At the Dudley Street Station (Legislative Route) escalators are provided between the mezzanine and the street surface, between the street surface and the bus loop platform, and between the mezzanine and the bus loop platform. In the initial contract an escalator will be installed in the Union Park Street Station from the mezzanine to the street and all planned escalators will be installed in the Dudley Street Station.

Wherever possible, the stairs from the mezzanine to the

street have been located inside of the building line in existing buildings which will be altered to suit this condition. Where stairways are to be located outside the building line, parapets and railings of dignified simple design are to be provided.

The station platform and mezzanine floors and stairs will be of reinforced concrete with non-slip finish on stairs and platform perimeter. Columns and walls are to be surfaced with tile and concrete ceilings and exposed steel will be painted. Provision will be made for advertising space on station walls.

(E) Above Ground Section

The portal of the underground section is located in the grounds of the Notre Dame Academy at Ritchie Street. At this location the tracks rise at a 3% grade and extend on a steel structure to the station at Columbus Avenue. Leaving the Columbus Avenue Station the right of way extends in a southwesterly direction on an extension of the earth embankment of the New York, New Haven and Hartford Railroad. Material for the extension of this embankment can most economically be obtained from the subway cut. The side slope of the embankment will be planted to prevent erosion. The right of way will be protected adjacent to the "New Haven" right of way at the top and on the property line at the bottom by chain link fences.

Designs and drawings were made of various types of structural steel and reinforced concrete structures for this section, but the earth embankment method proved to be the more desirable. Overhead structures will be provided at Atherton, Boylston and Green Streets

for the full width of the street with vertical clearance to permit passage of maximum allowable height vehicles.

1. Stony Brook Culvert

The existence of a large brick culvert under the right of way presented a somewhat difficult design problem. A field survey of this structure and an analysis of its strength indicated that it could not safely carry the proposed additional superimposed load. Various strengthening schemes were investigated, including the installation of a new lining of reinforced concrete, lining with steel plates, and the installation of interior struts. Consideration was even given to the advisability of demolishing the culvert and constructing a new structure outside the right of way. One scheme, consisting of driving piles adjacent to the side walls and constructing a new roof over the top, proved to present undesirable construction hazards and would entail extremely high costs.

Our field survey indicated that in several locations the arched roof deflected downward and the side walls deflected outward, indicating excessive roof load. The deflections were not great and relatively few cracks were found, but this condition led to a method which was given thorough detailed study.

This scheme consists of the installation of pre-cast reinforced concrete beams placed continuously and adjacent to each other over the top of the culvert structure, supported a short distance beyond each side wall with a space provided between the top of the culvert and

for the full width of the street with vertical clearance to permit passage of maximum allowable height vehicles.

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the underside of the beams. These beams are designed to support the new earth surcharge load and the live load of the rapid transit trains. The culvert roof pressure would thereby not be increased while the side pressure would be slightly increased. The resulting new stresses in the structure were analyzed and found to be within safe limits..

Many discussions of this problem were held with your Engineers. As a result of these discussions we have decided to incorporate in the estimate presented herein a scheme involving the installation of circular corrugated steel plates. These plates are to be joined to form a large circular conduit which has been designed to carry all loads from the new construction. The resulting cross-sectional area is only slightly less than that of the masonry culvert.

This installation should preferably be made in dry seasons. Openings will be made in the culvert roof at intervals and prefabricated sections of circular plates installed in sequence favorable to jointing. The space between the existing masonry culvert and the new steel plates will be filled with grout installed under pressure. The interior surface of the lining will be covered with shotcrete.

As noted above, the estimate presented herein includes the cost of the "Corrugated Steel Liner Plate Method" for reinforcing the Stony Brook Culvert. A detailed estimate of the "Precast Beam Method", which is on file in our office, indicates that the costs of both methods are approximately the same.

(F) Overhead Construction

Steel overhead construction is necessary at the junction of the embankment and the new subway structure and at the southerly end of the embankment where the right of way returns to the existing elevated structure at Washington Street and the Forest Hills Station. Both articulated column and girder and rigid frame designs were investigated. In some sections, particularly near the junction at Washington Street where clearance and other requirements result in a non-symmetrical pattern, articulated construction is indicated. In other locations the rigid frame type is considered preferable both from aesthetic and economic viewpoints and this method is proposed in these locations.

Except for incidental details, where welding may be used, the steel will be fabricated and field connected with rivets.

(G) Overhead Stations

There are only two overhead stations, one at Columbus Avenue and the other at Green Street. As in the case of the subway section, side platforms have been provided with a mezzanine for turnstiles and other operational requirements located between the street surface and the platform level. At Columbus Avenue the stairs and future escalators are located outside of the platform but at the Green Street Station right of way clearance requirements make it necessary to locate the stairway within the neat lines of the platforms.

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Concrete, steel and other durable materials have been

indicated in the station construction. Exposed structural steel is to be painted. Tile will not be used for finish as has been proposed in the below ground stations. In the final phase consideration may be given to the use of aluminum or stainless steel in side walls and other locations.

(H) Connections at Extremities

The connection of the new section to the existing subway at Boylston Street Station, where the elevated system descends from the superstructure to the underground right of way, involves an operation which must be accomplished without seriously interfering with existing rapid transit operations. Much of the new work will be performed during periods of minimum operations and the structural closure will be made after the traffic has been switched to the new facility.

At the Forest Hills end, part of the present overhead structure will be altered and reused in the new system. Here again a scheme of construction has been developed which will permit making the connection with a minimum of interference with rapid transit operations.

Traffic Interchanges

Interchanges between surface busses and trolleys are to be provided at the Dudley Street Station and at the Columbus Avenue Station. Many schemes were considered at these locations, the Dudley Street interchange presenting some difficult problems. At

this location peak hour traffic is particularly heavy and the solution is complicated by the existence of the overhead bus station in addition to platforms at the street surface. The proposed solution maintains both the street surface loading facilities and the easterly loop of the overhead bus terminal.

Uninterupted escalator service will be provided between the mezzanine level of the subway and the elevated bus terminal. Additional escalators will operate between the mezzanine level and the street surface and from the street surface to the elevated bus terminal.

At Columbus Avenue the problem is less involved and what we believe to be a straightforward, relatively simple layout has been provided.

Alternate Route, Dudley Street

The Legislative Route provides for a connection between the subway in Shawmut Avenue and the existing Dudley Street bus terminal. This requires that the alignment be detoured from Shawmut Avenue to Washington Street. Between these arteries the right of way extends under existing buildings and the underpinning problem is still further complicated by the necessity of constructing the subway under the present Washington Street Elevated structure and the overhead structure of the bus terminal.

In view of the above difficulties it was considered advisable to investigate the possibilities of departing from the alignment of the Legislative Route. Accordingly, alternate designs, drawings and

estimates of cost were made of an alignment which, instead of detouring back to Washington Street at Williams Street, extends continuously in Shawmut Avenue until it meets the original proposed right of way at Bartlett Street. This alternate alignment requires the construction of a new bus terminal and the demolition of the building leased by the Government for a post office, but despite these additional costs very substantial overall savings will result. The new alignment is also an improvement over that of the Legislative Route, from an operational viewpoint. This alternate alignment was developed by Mr. E. B. Myott, Superintendent of Engineering and Maintenance. Our engineering and cost studies bear out his good judgement in proposing this alternate.

Preliminary Field Work

After investigating the work which had previously been performed by others and conferring at length with the engineers of your Authority, field reconnaisance surveys were made by the principals of our office.

An instrument survey was then made of the entire section and the Plan and Profile was prepared on a long roll map.

A contract was awarded for borings at regular intervals through the area involved and logs of these borings were prepared. This work was supervised by our engineers. Types of soil as determined from the borings are indicated in the "Supplementary Drawings".

Subsequently, undisturbed samples obtained by the boring contractor were analyzed in a soils laboratory and the results were

tabulated and used in our foundation designs. A copy of the laboratory report was forwarded to your engineers.

A survey was made of all existing subsurface utilities throughout the entire right of way and record drawings were prepared showing the line and level of such utilities.

A survey was also made of all buildings on or adjacent to the right of way and from these data underpinning requirements were determined.

A real estate map was made from data obtained from city records and from our own surveys. These data were furnished to your real estate experts for their determination of condemnation costs.

Office Work

With the data obtained from the various sources noted above, alignment plans and profiles of the right of way were computed and drawn on consecutive sheets. These drawings show the tracks and other pertinent data. Similar drawings were prepared and furnished to your Engineering Department for their use in preparing track work, power, lighting and signal system drawings.

Simultaneous with the preparation of the alignment drawings, structural and architectural studies were made of the various component parts of the project.

During this phase of our work frequent consultations were held with your engineers and every effort was made to arrive at the best possible solution of all problems.

Suggested Sequence of Construction Operation at Strategic Locations

The construction procedures at several locations are involved and difficult. Many studies were made and the following paragraphs outline the sequence at these locations:

(A) Dudley Street Station

(1) Legislative Route

1. Remove elevated west loop and supporting columns.

2. Where necessary, underpin remaining elevated columns.

3. Build subway, stairs and escalators from street surface down to subway lobby, and lower two flights of stairs from lobby to elevated bus loop platform.

4. Switch elevated train traffic into subway.

5. Provide temporary decking over a limited length of elevated Northbound track and temporary railing around a section of existing elevated platform and the above-mentioned temporary decking to facilitate the movement of passengers from the street surface to the bus loop platform.

6. Remove all remaining elevated structures and supports except the bus loop and facilities indicated in step 5 above.

7. Remove elevated waiting room and regrade south end of existing east elevated platform to same slope as the adjacent bus loop platform.

8. Install escalators and complete construction of stairway from lobby to bus loop platform.

9. Put in use the facilities constructed in step 8 above and remove the temporary facilities of step 5 above together with their supports and

stairways leading thereto.

10. Build new stairs and escalators from street to bus loop platform.

11. Remove remaining central stairs and supports from street surface to bus loop platform and construct new surface waiting room.

(2) Alternate Route

1. No difficult problems would be encountered if the alternate route were adopted.

(B) Northerly Connection

1. Complete the new structure between the Brookley Road and Boylston Street Connections.

2. Drive soldier beams on the West side of the new alignment from beam 125 to 166.

3. Excavate North to beam 145 from the soldier beams to the existing subway wall down to invert grade, and uncover as much of the existing subway roof as possible.

(a) Place sheeting, decking and bracing as excavation progresses.

(b) Temporarily support East side of decking on the existing subway walls, columns and roof.

4. Construct the new invert from the existing West wall to the new West wall, and construct the new wall footing North to beam 145.

5. Construct the new West wall to beam 145.

6. Erect the new centerline columns and new West beams to 145.

7. Place temporary beams on top of the existing roof slab from the existing centerline columns to the new centerline columns to 145.

(a) Where necessary cut opening in the building foundation to admit beam and jack beam into position over the column.

(b) Where necessary place supports to reinforce existing center-line columns.

(c) Place the necessary "U" bolts from these beams to the existing roof beams near the existing West wall.

8. Shift decking supports to these beams where necessary.

9. Remove the existing West wall to beam 145.

10. Drive soldier beams from beam 167 to 210 on the West side and from 161 to 210 on the East Side.

11. Excavate North to beam 160 from the soldier beams to the existing subway wall down to invert grade and uncover as much of the existing subway roof as possible. Place sheeting and bracing as excavation proceeds.

12. Remove existing West roof beams and West wall from 146 to 160, and place decking in this area. Construct new invert and West wall to 160.

13. Place beams 146, 147 and 148 from the new West wall to the existing centerline girders.

14. Place temporary beams on top of the existing subway roof from the existing East wall to the new West wall from beam 149 to 160.

15. Place the necessary "U" bolts from these beams to the existing East roof beams near the existing center girders.

16. Shift the decking supports to these temporary beams where necessary.

(a) Where necessary cut opening in the building foundation to admit beam and jack beam into position over the column.

(b) Where necessary place supports to reinforce existing center-line columns.

(c) Place the necessary "U" bolts from these beams to the existing roof beams near the existing West wall.

8. Shift decking supports to these beams where necessary.

9. Remove the existing West wall to beam 145.

10. Drive soldier beams from beam 167 to 210 on the West side and from 161 to 210 on the East Side.

11. Excavate North to beam 160 from the soldier beams to the existing subway roof as possible. Place sheeting and bracing as excavation proceeds.

12. Remove existing West roof beams and West wall from 146 to 160, and place decking in this area. Construct new invert and West wall to 160.

13. Place beams 146, 147 and 148 from the new West wall to the existing centerline girders.

14. Place temporary beams on top of the existing subway roof from the existing East wall to the new West wall from beam 149 to 160

15. Place the necessary "U" bolts from these beams to the existing East roof beams near the existing center girders.

16. Shift the decking supports to these temporary beams where necessary.

17. Remove the existing centerline columns and girders from 150 to 160.

18. Excavate North to beam 210 on the West side and from beam 161 to 210 on the East side. The excavation shall be to invert grade on the sides and to the existing subway roof. Place sheeting and bracing as the excavation proceeds.

19. Remove the existing roof, center columns and West wall from beam 161 to 210. Place decking.

20. Remove the existing East Wall from beam 161 to 185.

21. Construct remainder of new invert from the existing West wall line to the new West wall line and the wall footing. Also construct the new West wall to beam 210.

(a) Extend the ventilation duct.

22. Install the new track on the new alignment with a minimum of interference with traffic, and detour traffic to the new alignment.

23. Construct the new East wall from 125 to 185, and connect the new East wall to the old East wall near beam 160.

24. Burn off the portions of the old West beams, from 125 to 145, that extend beyond the center of the new East wall.

25. Erect the new East beams and construct the roof to beam 145.

26. Burn off the portions of previously placed beams 146, 147 and 148 that extend beyond the center of the new East wall.

27. Burn off the portions of the old East beams from 149 to 160 that extend beyond the center of the new East wall.

28. Erect new roof beams 149 to 210 and construct the new roof.

29. Repair building foundation damaged during construction.

30. Remove bracing, temporary beams and supports. Backfill, remove decking and place temporary pavement.

(C) Southerly Connection

1. Support existing bents 823 to 826 incl. by means of temporary girders, struts and columns on timber grillages.

2. Remove existing footings under bents 823 to 826 incl. and replace with new footings.

3. Reinforce existing columns 823 to 826 incl. by welding a 3/4 x 15" plate to each column flange.

4. Attach reinforced columns to the new footings and remove the temporary supporting members.

5. Extend bent 826 as shown.

6. Erect new West stringer between bents 823 to 825.

Erect two Westerly stringers between bents 825 and 826.

Erect four stringers between bents 826 and 827.

7. Erect framing as shown.

8. Lay tracks on the new alignment and reroute trains.

Suggested Division of Construction Contracts

The entire work involves as estimated total construction cost exceeding $ 28,000,000. This is considered too large for construction under a single contract. We consider it inadvisable to divide the work into a large number of relatively small contracts but are of the opinion that the work should be divided into not less than four prime

general contracts.

The following divisions separate the contracts into similar types of construction:

1. From existing Boylston Station to Dover Street (2,800' ±)
2. From Dover Street to Lenox Street (4,800' ±)
3. From Lenox Street to end of incline at Ritchie St. (7,700' ±)
4. From end of incline at Ritchie St. to Forest Hills (7,400' ±)

Basis of Design

The following design criteria have been used in our Preliminary Phase computations and are also suggested for use in the Plan Phase. Where applicable they are similar to those recommended and approved for the Tremont Street Subway but they have been amplified to provide for special features of this project. In the final design conditions may arise which are not foreseen in standard codes. Such conditions may require amplification or modification of these requirements.

(A) Codes

1. In the execution of the contract entered under these specifications, the following codes, as amended to date, shall apply except as herein specified or modified.

Structural Steel - General	A. I. S. C.
Structural Steel - Special	A. R. E. A.
Structural Steel - Special	A. A. S. H. O.
Timber	As specified
Concrete	A. C. I., Joint Committee Code

(B) Loads and Forces

1. Dead and Live Loads:

a. The dead load shall consist of the weight of the structure complete, including all material permanently fastened thereto or supported thereby.

(1) Cover loads in these specifications is meant to be the combined weight of the roof construction (beams, slab, etc.) and the overlying earth.

b. Live load shall consist of any uniform or concentrated movable load which may be displaced either by reason of operation or any other cause.

(1) The load on elevated and subway tracks shall be taken as a single or continuous train of rapid transit or trolley cars with axle loads of the amounts and spacings given in tables 1 and 2 respectively.

Axle Load (Kips)	35	35	35	35	
Spacing (Feet)	8.83	6.83	37.75	6.83	8.83

Table 1.

Axle Load (Kips)	25	25	25	25	
Spacing (Feet)	8.33	6.00	26.29	6.00	8.33

Table 2.

(2) Where the structure supports railroad trains, the design shall be made in accordance with the requirements of the railroad company concerned, but in no case shall the loading be less

(B) Loads and Forces

1. Dead and Live Loads:

a. The dead load shall consist of the weight of the structure complete, including all material permanently incorporated therein or supported thereby.

(1) Cover loads in these specifications is meant to be the combined weight of the road construction (beams, slab, etc.) and the overlying earth.

b. Live load shall consist of any uniform or concentrated movable load which may be displaced either by reason of operation or any other cause.

(1) The load on elevated and subway tracks shall be taken as a single or continuous train of rapid transit or trolley cars with axle loads of the amounts and spacings given in tables 1 and 2 respectively.

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Table 1.

Axle Load (Kips)	25	25	25	25
Spacing (Feet)	8.33	6.00	26.29	6.00	8.33

Table 2.

(2) Where the structure supports railroad trains, the design shall be made in accordance with the requirements of the railroad company concerned, but in no case shall the loading be less

than that recommended by the American Railway Engineering Association.

(3) The live load from sidewalks over subways shall be taken at 600 pounds per square foot.

(4) The live load from roadways over subways shall be computed by one of the following methods. Whichever method causes the higher stress shall be used.

(a) For a cover of 2 feet the live load shall be taken as 1,300 pounds per square foot of roadway surface, decreasing by 100 pounds per square foot for each additional foot of cover up to 9 feet. At 9 feet of cover the live load becomes 600 pounds per square foot and remains at this value for all covers exceeding 9 feet.

(b) The live load shall be taken as a local concentration of 200 kips on four wheels, 12 feet between axles and 6 foot gauge. Each of these wheel loads shall be considered distributed over an area of 2 feet by 2 feet on the pavement and then through the soil and roof at a slope of 1 horizontal to 2 vertical.

(5) The live load, in lbs. per sq. ft., on other surfaces of subway and elevated structures shall be assumed as follows:

Canopy Roofs	30
Service Walks	150
Platforms and Mezzanine Floors	150
Stairs, on horizontal projection	150

One-half the above values shall be used for the design of elevated columns.

Floors of Maintenance and Service Rooms, Duct Manholes	150
" " Dispatchers', Trainmen's and Motormen's Quarters	200
" " Third Railmen's and Trackmen's Quarters	200
" " Battery Rooms	200
" " Signal Towers	200
" " Transformer Closets	200
" " Control Rooms	300
" " Circuit Breaker Rooms	400
" " Compressor Rooms	500
" " Sump and Pump Chambers	500
Storage Spaces in Subways	500
Floors of Fan Chambers	600
Floors of Rectifier Rooms	800

2. Building Load

a. When the subway passes under private property, it shall be designed for "Building Load". Each case shall be considered on its own merits.

b. A reduction of the total live load to be assumed as affecting subways shall be permitted according to the following schedule.* No reduction shall be allowed in the roof load.

Per Cent Live Load Reductions

Occupancies for which prescribed Live Load per Square Foot is -	Number of Stories is - 2	3	4	5	6 or more
125 pounds or less	15	20	30	40	50
Over 125 pounds, except garages	5	10	15	20	20
Garages, all classes	25	25	25	25	25

c. Buildings up to 6 stories in height shall generally be designed for a uniform load. For buildings in excess of 6 stories, future building columns shall be fixed beforehand and grillages provided in the subway roof construction for their support.

* From Building Code of the City of Boston.

Floors of Maintenance and Service Rooms, Duct Manholes 150

d. Special conditions may arise which, if the general rules of sub-section "c" above were rigidly adhered to, would cause undue restriction in locating future building columns. In such cases the subway may be designed for a uniform load irrespective of the height of the building to be supported, provided that the building load can be satisfactorily distributed at the bottom of the subway for all reasonable column locations.

e. Where building locations and loads have not absolutely been determined, the following procedure shall be followed. The footing supporting piers and columns shall generally be assumed to be spread over an area equal to one-half that of the corresponding panels. The load transmitted to the subway roof shall then be taken as equal to twice the total from roof and floors as determined from subsection "b" above. The following additional loads shall be superimposed on this load, which is assumed to be applied to every square foot of subway roof.

(1) Dead weight of front wall: This load shall be considered spread over a strip 4 feet wide, of which 1 foot is outside the building line. Where the subway roof is less than 10 feet below the street surface, the load shall be considered spread over a strip 3 feet wide, flush with the building line. Where buildings are in excess of 6 stories in height, the width of the strips referred to above shall be increased by being extended to the middle of the end panel.

d. Special conditions may arise which, if the general rules of sub-section "c" above were rigidly adhered to, would cause undue restriction in locating future building columns. In such cases the subway may be designed for a moderate load irrespective of the height of the building to be supported, provided that the building load can be satisfactorily distributed at the bottom of the subway for all foreseeable column locations.

e. Where building locations and loads have not absolutely been determined, the following procedure shall be followed. The loading supporting piers and columns shall generally be assumed to be spread over an area equal to one-half that of the corresponding panels. The load transmitted to the subway roof shall then be taken as equal to twice the total trunk roof and floors as determined from subsection "b" above. The following additional loads shall be superimposed on this load, which is assumed to be applied to every square foot of subway roof.

(1) Dead weight of front wall: This load shall be considered spread over a strip 4 feet wide, at right angles to the building line. Where the subway roof is less than 10 feet below the street surface, the load shall be considered spread over a strip 3 feet wide, also with the building line. Where buildings are in excess of 5 stories in height, the width of the strips referred to above shall be increased by being extended in the middle of the end panel.

(2) Dead weight of lot line walls: These loads shall be considered spread over strips 3 feet wide, flush with lot lines. Where buildings are in excess of 6 stories in height, the width of the strips referred to above shall be increased by being extended to the middle of the end panel.

(3) The weight of the subway roof and overlying soil shall be taken at 100 pounds per square foot for every foot between the cellar floor level and the underside of the transverse roof members. Where the subway roof is below water, 25 pounds per square foot shall be added for every foot of ground water head above the top of the roof.

3. Side Pressure on Subways:

a. The subway shall be designed for side pressure due to earth abutting against the subway wall, loads resting on abutting earth, and water producing hydrostatic pressure.

b. In designing for overlying loads, the following shall be adhered to:

(1) Street live load shall not be included when calculating loads from footings or earth.

(2) Floor loads shall include live loads. The live load on track floors shall be taken as 450 pounds per square foot.

(3) When an overlying foundation is not continuous longitudinally, the load shall be considered distributed over a length equal to the length of the foundation plus twice the transverse

distance from the net line of the lower wall to the near edge of the foundation. However, in no case shall the increased length exceed the longitudinal distance between centers of adjacent foundations.

c. A minimum side pressure of 200 pounds per square foot shall be used for walls in earth near the street surface.

d. Side pressure due to water shall be considered.

e. Where the active side pressures against opposite sides of a structure in earth are unequal, the greater pressure shall be considered for both sides.

4. Impact

Impact effects shall be accounted for by designing members for additional forces whose magnitudes are to be determined according to the respective code. In general, impact for subway trains shall not be less than

$$I = \frac{150 - \frac{L}{6}}{450 + L} 100 \qquad (1)$$

where I = increase in percent of the live load on a single track and L = length of span in feet.

For members supporting several tracks, such as cross girders and columns, L = length of adjacent spans for one track only.

Where a member supports more than one track, the number of tracks assumed loaded shall be such as will produce the maximum stress in the member, but the impact increase shall be

applied only to that track which when loaded contributes most to the live load stress.

For trolley cars and railroad trains the values yielded by the formula given above shall be multiplied by 3.

5. Lateral Forces on Elevated Structures.

a. Wind force shall be computed at 30 p. s. f. of vertical projection of exposed surface. For two track structures the exposed surface of one train shall be considered. The wind force on trains shall be considered as applied six feet above Base of Rail. Where wind screens at platforms are considered as part of the exposed surface, the wind force on one train may be disregarded, provided the wind force on the screens is greater than that on one train.

b. Tractive force shall be computed as ten percent of the weight of the train uniformly distributed along the length of the train and shall be assumed to stress the columns resisting such tractive force in bending only. All columns between expansion joints in a single line parallel to the track shall be assumed to resist an equal amount of the tractive force, except that where there is a considerable difference in the stiffness of columns, the force resisted by each column shall be assumed to be in proportion to its stiffness which is defined as moment of inertia divided by length.

c. Centrifugal force shall be computed through use of the following formula:

$$F = CW \qquad (2)$$

Where: F = Centrifugal Force

C = Coefficient depending upon degree of curvature as per table below

W = Weight of train per foot

Degree of Curvature	Radius in Ft.	C	Degree of Curvature	Radius in Ft.	C	Degree of Curvature	Radius in Ft.	C
1	5,730	0.020	8	717	0.120	15	383	0.120
2	2,865	0.040	9	637	0.126	16	359	0.112
3	1,910	0.060	10	574	0.130	17	338	0.102
4	1,433	0.076	11	522	0.132	18	320	0.090
5	1,146	0.090	12	478	0.132	19	303	0.076
6	955	0.102	13	442	0.130	20	288	0.060
7	819	0.112	14	410	0.126			

Centrifugal forces shall be neglected for curves of less than one degree, while for curves exceeding twenty degrees the value of C shall be taken as 0.060.

d. Provision shall be made in designing steel structures for a variation in temperature from -10 to +110 degrees Fahrenheit, and, in designing masonry structures such as viaduct arches, for a variation from +20 to +80 degrees Fahrenheit.

(C) General Design Procedure

1. Roof beams, girders and columns shall be designed for full uniform load and for any additional concentrated load as determined from design.

2. Exterior columns supporting side walls shall be designed for the combined stresses due to the horizontal earth pressure (and water and surcharge, if any) and the direct axial load. The columns shall be designed as follows:

$$F = CW \qquad (2)$$

Where: F = Centrifugal Force

C = Centrifugal expressed even degree curvature as per table below

W = Weight of train per foot

Degree of Curvature	Radius in Ft.	C	Degree of Curvature	Radius in Ft.	C	Degree of Curvature	Radius in Ft.	C
1	5,730	0.020	8	717	0.120	15	383	0.120
2	2,865	0.040	9	637	0.126	16	359	0.112
3	1,910	0.060	10	574	0.130	17	338	0.102
4	1,433	0.076	11	522	0.132	18	320	0.090
5	1,146	0.090	12	478	0.132	19	303	0.076
6	955	0.102	13	442	0.130	20	288	0.060
7	819	0.112	14	410	0.126			

a. When the direct load P does not exceed 150 kips, one half the load is assumed to be carried by the concrete wall and the other half by the column and the maximum allowable steel stress due to combined direct load and bending is 25 kip per sq. in. For $P \leq 150$ kip, the permissible bending stress is thus

$$f_{B1} = 25 - \frac{P}{2A} \qquad (3)$$

b. As the direct load P increases beyond 150 kip, gradually less of it is assumed to be carried by the concrete wall, until, when P reaches the maximum value of $f'_D A$, the concrete is disregarded, and the maximum allowable stress due to the combined direct load and bending is 20 kip per sq. in. For the latter condition, the permissible bending stress is thus:

$$f_{B2} = 20 - f'_D \qquad (4)$$

c. Between the limits defined by a. and b., a straight line interpolation shall be used for determining the permissible bending stress. For $150 < P < f'_D A$ the permissible bending stress is thus:

$$f_B = f_{B2} + (f_{B1} - f_{B2}) \frac{f'_D A - P}{f'_D A - 150} \quad \text{or} \qquad (5a)$$

$$f_B = (20 - f'_D) + (5 + f'_D - \frac{150}{2A}) \frac{f'_D A - P}{f'_D A - 150} \qquad (5b)$$

Where:

A = Area of column section in sq. in.

P = Total direct load in kip.

f'_D = Maximum allowable direct stress in kip per sq. in.

f'_D = Maximum allowable direct stress in kip per sq. in.

P = Total direct load in kip.

A = Area of column section in sq. in.

Where:

$$f_B = (20 - f'_D) + (5 + f'_B - \frac{150}{f'_{DA} - 150}) \frac{f'_{DA} - P}{2A} \quad (5b)$$

$$f_B = f_{B2} + (f_{B1} - f_{B2}) \frac{f'_{DA} - P}{f'_{DA} - 150} \quad \text{or} \quad (5a)$$

line interpolation shall be used for determining the permissible bending stress as follows: For $150 < P < f'_{DA}$ the permissible bending stress is

c. Between the limits defined by a. and b., a straight

$$f_{B2} = 20 - f'_D \quad (4)$$

the permissible bending stress is thus:

direct load and bending is 20 kip per sq. in. For the latter condition,

diaphragms, and the maximum allowable stress due to the combined

until, when P reaches the maximum value of f'_{DA}, the concrete is

gradually less as it is assumed to be carried by the concrete wall,

b. As the direct load P increases beyond 150 kip,

$$f_{B1} = 25 - \frac{P}{2A} \quad (3)$$

kip, the permissible bending stress is thus

to combined direct load and bending is 25 kip per sq. in. For P $\leq$ 150

other half by the column and the maximum allowable steel stress due

but the load is assumed to be carried by the concrete wall and the

a. When the direct load P does not exceed 150 kips, one

f_{B1} = Maximum allowable bending stress in kip per sq. in. for $P \leq 150$ kip.

f_{B2} = Maximum allowable bending stress in kip per sq. in. for $P = f'_D A$.

f_B = Maximum allowable bending stress in kip per sq. in. for $150 < P < f'_D A$

d. Side wall columns shall be investigated for the effects of eccentricity by utilizing the following:

(1) Where a roof member bears on the inside flange of a column, the total stress in the flange due to axial and bending stresses may not exceed 20 kip per square inch. The moment due to eccentricity shall be computed as the load multiplied by:

0.5 column depth when roof member is a girder
0.4 " " " " " " " beam with stiffeners
0.3 " " " " " " " without stiffeners

(2) When eccentric cantilever footings are used, the sum of stresses on the inside column flange shall not exceed 20 kips per square inch, except where the inside column flange is imbedded in concrete for a height of at least one-fourth of the span in accordance with section D. 1. (7)(a), in which case the allowable stress may be raised to 25 kips per square inch. The moment shall be taken as load multiplied by the distance between the center line of the column and the center of the footing.

3. Subway inverts distributing loads over the entire subgrade shall be designed for their total load as determined from design,

but in no case shall inverts of this type be designed for a total load of less than 900 pounds per square foot.

4. Grillages, base slabs and footings shall be designed for their total load as determined from design.

a. Grillage beams shall have sufficient flange bearing area, considering both flanges, to transmit safely the superimposed load to the concrete at the allowable unit bearing stress. The clear distance between flanges of grillage beams shall be not less than 2-1/2 inches.

b. Grillages shall be designed to resist moment, shear and full bearing under the column. Web buckling shall not be considered when the beams are encased in concrete and the load is applied after the concrete has set.

c. Grillage beams shall have a depth of not less than 6 inches or a length of not less than 18 inches.

d. In general, concrete or steel grillage footings may be used for isolated subway footings with a total column load not in excess of 100 kip. When the total column load exceeds 100 kip, grillages shall be used.

5. Elevated steel column bases and their supporting grillages, if any, shall be designed for the same combinations of forces as are specified for elevated columns in section D. 4. d and B. 5. Since the highest stresses are generally produced through the combined action of direct load, wind, traction, and centrifugal

force (on curves), the allowable stresses for such design shall be increased 25 per cent.

6. All concrete structures shall be designed in accordance with the requirements of the American Concrete Institute or Joint Committee Code. In cases of discrepancy, the Joint Committee Code shall govern.

(D) Allowable Stresses

The following unit stresses in kips per square inch shall govern the design of all members as mentioned in Section A. (These unit stresses are tentative and are subject to future revision.)

1. Structural Steel, Rivets, Bolts, and Weld Metal

a. Tension, net section:

Structural shapes	20
Welds	13

b. Compression:

Members in which $L/r \geq 3$	20
Subway columns	$20-0.095 L/r$*
but not to exceed	16.5
Elevated columns	$18.5-0.09 L/r$*
but not to exceed	15
Welds	15

c. Bending, extreme fibre:

Structural shapes except as noted in subsections (3) and (7) to (11)	20

*The value of L/r shall not exceed 100 for main members or 150 for secondary members including bracing.

force (on curves), the allowable stresses for such design shall be increased 25 per cent.

6. All concrete structures shall be designed in accordance with the requirements of the American Concrete Institute or Local Committee Code. In cases of discrepancy, the Local Committee Code shall govern.

(B) Allowable Stresses

The following unit stresses in kips per square inch shall govern the design of all members as mentioned in Section A. (These unit stresses are tentative and are subject to future revision.)

1. Structural Steel, Rivets, Bolts, and Weld Metal:

a. Tension, net section:

Structural shapes	20
Welds	13

b. Compression:

Members in which $L_y/r \leq 3$	20
Subway columns:	$20-0.095L_y/r$*
but not to exceed	16.5
Elevated columns	$18.5-0.09L_y/r$*
but not to exceed	15
Welds	15

c. Bending, extreme fibre:

Structural shapes except as noted in (1a) and (1b) 24

*The value of L_y/r shall not exceed 100 for main members or 150 for secondary members including bracing.

Pins, turned bolts	30
d. Bearing:	
Structural shapes	20
Pins, turned bolts and shop rivets	30
Field rivets, power driven	25
Rollers, kip per lineal inch	0.75d
e. Shear:	
Webs, gross section except as noted in subsection (3)	12.5
Pins, turned bolts and shop rivets	15
Field rivets, power driven	12.5
Welds, kip per lineal inch:	
1/4" nominal size	2
3/8" " "	3
1/2" " "	4
5/8" " "	5

(1) For temporary work use stresses in Section F.

(2) Rivet holes and isolated holes up to 1 inch in diameter shall not be considered as reducing the web area for resisting shear.

(3) At copings and re-entrant cuts the allowable unit stresses for shear and bending shall be reduced to 10 and 15 kips per square inch, respectively.

(4) The allowable unit stresses for special steels shall be higher than those given for steel in proportion to the minimum ultimate tensile stresses.

Pins, turned bolts	18
d. Bearing:	
Structural shapes	25
Pins, turned bolts and shop rivets	30
Field rivets, power driven	25
Rollers, kip per lineal inch	0.75d
e. Shear:	
Webs, gross section except at rivet holes	
Pins, turned bolts and shop rivets	15
Field rivets, power driven	12.5
Welds, kip per lineal inch.	
1/4" nominal size	2
3/8" " "	3
1/2" " "	4
5/8" " "	5

(1) For temporary work use stresses in Section F.

(2) Rivet holes and fastened holes up to 1 inch in diameter shall not be considered as reducing the net area for tensile shear.

(3) At copings and re-entrant cuts the allowable unit stresses for shear and bending shall be reduced to 10 and 15 kips per square inch, respectively.

(4) The allowable unit stresses for special steels shall be higher than those given for steel in proportion to the minimum ultimate tensile stresses.

(5). The allowable unit stress in shear shall be used for rivets stressed in tension only if the connection is symmetrical, and one-half of this value if the connection is unsymmetrical. Where rivets are subjected to shear and tension, the tensile component shall be considered to be a shearing force of twice the amount. Ordinary framed end connections are excepted.

(6) Where the subway is to be designed for building load, it shall be designed in accordance with pertinent Building Code stresses unless those unit stresses specified herein are lower.

(7) The allowable bending stress in structural steel may be increased to 25 kips per square inch where concrete may be counted on to act integrally with the steel. (Note exceptions in subsection (8) below.) This applies to:

(a) Beams and girders having their compression flange embedded in a flat slab which extends in depth at least 1/3 the distance to the extreme tension fibre, and in width at least 1/2 the depth of the member beyond both flange members.

(b) Beams and girders encased between subway roof arches.

(c) Longitudinal mezzanine and platform roof members with other members framed into them on both sides and having their compression flange embedded in concrete for a width as specified above.

(8) No increase in bending stress shall be allowed for:

Roof members located between building lines of intersecting streets where the top of the subway roof is less than 7 feet below the street surface.

Members placed closer center to center than the sum of depth and flange width.

Members having a nominal depth in excess of 36 inches.

Rectangular sections stressed in shear and bending, such as web plates extended longitudinally beyond flanges of girders.

(9) When special steels are used, the additional bending stress allowed due to concrete embedment may be 5 kips per square inch, subject to the exceptions noted in subsection (8) above.

(10) Where the ratio of the unbraced length of compression flange of beams and girders to the flange width exceeds 16, the allowable compressive stress shall be in kips per square inch = $25 - 0.31\ L/w$ where L = unbraced flange length in inches and w = flange width in inches.

(11) For beams and girders, where the ratio of span to depth exceeds the factor (k) which is 12 for members supporting tracks and 20 for all other members, the allowable bending stress shall be reduced to = $f\ k\ d/L$ where f = original bending stress, k = appropriate constant as mentioned above, d = depth of member in inches and L = span length in inches.

2. Timber

	Long Leaf Pine, Fir	Short Leaf Pine	White Pine, Spruce	White Oak
Bending extreme fibre:	1.6	1.25	1.25	1.40
Compression, parallel to grain:				
for $L/d > 15$	$1.6\left(\frac{1-L}{60d}\right)$	$1.25\left(\frac{1-L}{60d}\right)$	$1.25\left(\frac{1-L}{60d}\right)$	$1.6\left(\frac{1-L}{60d}\right)$
for $L/d \leq 15$	1.2	0.94	0.94	1.20
perpendicular to grain	0.32	0.20	0.20	0.56
Shear	0.15	0.15	0.09	0.14
Modulus of Elasticity*	1,500	1,500	1,200	1,200

The stresses given are for green timber and shall be used without increase of live load stresses for impact.

For building and similar structures in which the timber is protected from weather and is practically free from impact, the stresses may be increased 25 percent.

3. Allowable bearing values for soils in kips per square foot.

Sound ledge rock	60 to 150
Hardpan or compact gravel	20
Coarse sand or gravel	12
Clean sand or dry clay	8
Clay, moist	up to 4

The above values are subject to change due to existing conditions.

*For long continued loading the Modulus of Elasticity shall be reduced to 50 percent of the above values.

3. Timber:

	Long Leaf Pine, Fir	Short Leaf Pine	White Pine, Spruce	White Oak
Bending extreme fibre:	1.6	1.25	1.25	1.40
Compression, parallel to grain:				
for $L/d \leq 15$	1.2	0.94	0.94	1.20
Shear	0.15	0.15	0.09	0.14
Modulus of Elasticity*	1,500	1,500	1,200	1,200

The stresses given are for green timber and shall be used without increase of live load stresses for impact.

For building and similar structures in which the timber is protected from weather and is practically free from impact, the stresses may be increased 25 percent.

4. Allowable bearing values for soils in tons per square foot:

Sound ledge rock	60 to 150
Hardpan or compact gravel	20
Coarse sand or gravel	12
Clean sand or dry clay	8
Clay, moist	up to 4

The above values are subject to change due to existing conditions.

*For long continued loading the Modulus of Elasticity shall be reduced to 50 percent of the above values.

4. Combined stresses:

a. Interior subway columns, in which compression and bending stresses due to side thrust are combined, shall be designed for a unit bending stress $\frac{Mc}{I} = 20 - \frac{P \times 20}{A f'_d}$, where f'_d = allowable direct load stress in kips per square inch from the column formula given in section 1, with a maximum of 16.5, P = direct load in kips, A = area of column section in square inches, M = actual bending moment, and $\frac{I}{C}$ = section modulus. The effect of eccentric loading on interior columns may be neglected.

b. For subway side wall columns see section C2.

c. Compression due to side pressure shall be neglected in the design of roof and invert members. Side pressure shall be considered in designing intermediate floor beams which shall be designed as follows:

When the beam meets the requirements of subsection 1 (7), assume one-half the direct side pressure as being taken by the beams and allow a combined bending and direct stress of 25 kips per square inch. In all other cases, assume the beams to take full side pressure and allow a combined stress of 20 kips per square inch. (See subsection 1 (11).

d. For Elevated Railway Structures, the following allowable stresses shall apply:

(1) Stringers:

When considering D only - Values given in Section 1.

4. Combined stresses.

a. Interior subway columns, in which compression and bending stresses due to side thrust are considered, shall be designed for a unit bending stress $f_b = \frac{Mc}{I} = \frac{P}{A} \frac{e}{r^2 d}$, where f_b = allowable direct load stress in kips per square inch from the column formula given in section 1, with a maximum of 16.5, P = direct load in kips, A = area of column section in square inches, M = actual bending moment, and $\frac{I}{c}$ = section modulus. The effect of eccentric loading on interior columns may be neglected.

b. For subway side wall columns see section C2.

c. Compression due to side pressure shall be neglected in the design of roof and invert members. Side pressure shall be considered in designing intermediate floor beams which shall be designed as follows:

When the beam meets the requirements of subsection 1 (7), assume one-half the direct side pressure as being taken by the beams and allow a combined bending and direct stress of 25 kips per square inch. In all other cases, assume the beams to take full side pressure and allow a combined stress of 20 kips per square inch. (See subsection 1 (11).

d. For Elevated Railway Structures, the following allowable stresses shall apply:

(1) Stringers:

When considering D only - Values given in Section 1.

When considering P only - Values given in Section 1 increased by 25 per cent.

(2) Cross Girders - Values given in Section 1. (The effects of wind and centrifugal force shall be disregarded.)

(3) Columns

When considering P only - Values given in Section 1.

" " P and T_h - 20 kip per square inch.

" " P, W_h and C_h - 20 kip per square inch.

" " P, W_h, C_h, and T_h - 25 kip per square inch.

Where:

D = Direct load (live load + dead load + impact).

W = Vertical force due to wind.

C = Vertical force due to centrifugal action.

P = D + W, with rails properly superelevated = D + W + C, where no superelevation is provided.

W_h = Horizontal force due to wind.

C_h = Horizontal force due to centrifugal action.

T_h = Horizontal force due to traction.

(E) Waterproofing

Subway structures shall be waterproofed as follows:

1. Invert: 6-ply waterproofing and 4" concrete.

2. Roof:

a. Above ground water level:

(1) At stations: 4-ply waterproofing and 4" concrete.

(2) Between stations: 3-ply waterproofing and 4" concrete.

b. Below ground water level:

(1) At and between stations: 4-ply waterproofing and 4" concrete.

3. Sidewalls:

a. Above approximately 12 feet below ground water level:

4-ply waterproofing and 4" concrete.

b. Below approximately 12 feet below ground water level:

6-ply waterproofing and 4" concrete.

(F) Loads and Stresses for Decking and Temporary Work

1. Loads:

a. The dead load shall include the weight of all structures fixed in location for the life of the decking.

b. The live load shall be computed in either of the following ways:

(1) 200 pounds per square foot over the entire area of sidewalks and roadway.

(2) A local concentration of 20 kips on one axle with a 5 foot wheel gauge.

(3) For trolley cars as specified in section B.

(4) Loading due to construction equipment shall be substituted where such loading is in excess of the above.

2. Allowable unit stresses in kips per square inch.

a. Steel:

(1) Tension, net section 20

(2) Between stations: 3-ply waterproofing and 4" concrete.

b. Below ground water level:

(1) At and between stations: 4-ply waterproofing and 4" concrete.

3. Sidewalls:

a. Above approximately 12 feet below ground water level:

4-ply waterproofing and 4" concrete.

b. Below approximately 12 feet below ground water level:

6-ply waterproofing and 4" concrete.

(7) Loads and Stresses for Decking and Temporary Work

1. Loads

a. The dead load shall include the weight of all structures fixed in location for the life of the decking.

b. The live load shall be computed in either of the following ways:

(1) 200 pounds per square foot over the entire area of sidewalks and roadway.

(2) A local concentration of 20 kips on one axle with a 5 foot wheel gauge.

(3) For trolley cars as specified in section B.

(4) Loading due to construction equipment shall be substituted where such loading is in excess of the above.

2. Allowable unit stresses in kips per square inch.

a. Steel:

(1) Tension, net section 20

(2) Compression	$20 - 0.095 L/r$
but not to exceed	16.5
(3) Bending, extreme fibre	20
(4) Bearing:	
Structural shapes	30
Turned bolts	30
Field rivets, power driven	25
(5) Shear:	
Structural shapes, gross section	15
Turned bolts	15
Field rivets, power driven	12.5
(6) Welds, 1/4" nominal size	2
3/8" " "	3
1/2" " "	4
5/8" " "	5

b. Timber:

The same allowable unit stresses shall be used as are given in section D.

(2) Compression	20 - 0.095 L/r
but not to exceed	16.5
(3) Bending, extreme fibre	20
(4) Bearing:	
Structural shapes	30
Turned bolts	30
Field rivets, power driven	25
(5) Shear	
Structural shapes, gross section	15
Turned bolts	15
Field rivets, power driven	12.5
(6) Welds, 1/4" nominal size	2
3/8" " "	3
1/2" " "	4
5/8" " "	5

6. Timber:

The unit allowable unit stresses shall be used as are given in section 23:

Specifications

Contract specifications and other documents have recently been prepared for the Tremont Street Subway. These specifications covering somewhat similar construction, may be used as a guide in preparing the final specifications and other contract documents for this project.

Design of Facilities Prepared by the M. T. A.

Track work, signal system, power and lighting designs were prepared by the Engineering Department of the M. T. A. and prints of the preliminary drawings of this work are attached to our drawings.

Estimates of land damages, track work, signal system, power, and lighting were also prepared by the M. T. A. and are included in this report.

The following descriptions of Power, Signal System, Lighting, and Track Work were furnished us by the Engineering and Maintenance Department of the M. T. A.

Power

This extension will require some alteration and extension of the present power lines in the Washington Street Tunnel.

In general, duct lines and conduits will be provided in the new subway section for lighting and signals as well as for the

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Power

This extension will require some alteration and extension of the present power lines in the Washington Street Tunnel.

In general, duct lines and conduits will be provided in the new subway section for lighting and signals as well as for the

power cables. The removal of the present elevated structures along Washington Street which now support the surface car trolley wires, will require the erection of some new poles and wires.

The work also includes new overhead trolley wires between Egleston Square and the proposed new station at Columbus Avenue. The main power cables will be extended from the sub-stations at Dudley and Egleston to the new rapid transit line.

The power installations include distribution conduit, cables, switches, overhead trolley wire, power feed and frequency changers.

Signal System

The signal system includes 89 three color automatic block signals each with electro pneumatic train stop to enforce the stop indication.

The signalling is designed for an operating headway of 90 seconds with trains of either 8 cars of the existing vehicles or 6 cars of a possible future 60' car.

Control of the speed of trains by signals, on curves and grades and to approaching occupied stations, has been designed as required for operating safety.

Also included are short line telephones needed for train operation only, as well as train position indications for the Signal Tower at Forest Hills.

Lighting

The lighting work includes all lighting fixtures for

power cables. The removal of the present elevated structures along Washington Street which now support the surface car trolley wires, will require the erection of some new poles and wires.

The work also includes new overhead trolley wires between Egleston Square and the proposed new station at Columbus Avenue. The main power cables will be extended from the sub-stations at Dudley and Egleston to the new rapid transit line.

The power installations include distribution conduit, cables, switches, overhead trolley wire, power feed and trolley changers.

Signal System

The signal system includes 89 three color automatic block signals each with electro pneumatic train stop to enforce the stop indication.

The signalling is designed for an operating headway of 90 seconds with trains of either 4 cars of the existing vehicles or 6 cars of a possible future 60' car.

Control of the speed of trains by signals, on curves and grades and in approaching occupied stations, has been designed as required for operating safety.

Also included are short line telephones needed for train operation only, as well as train position indications for the Signal Tower at Forest Hills.

Lighting

The lighting work includes all lighting fixtures for

stations and subway illumination, line wiring, switching and protection. Also included are all main light fixtures, load centers, transformers, primary cables and connections for automatic Edison emergency service in the event of M.T.A. power failure in the subway section and at stations.

Incandescent lighting will be used of 60-cycle A.C. The fixtures are suitable for either 150 or 200 watt lamps producing an average illumination level of approximately 8 or 12 foot candles.

Miscellaneous electrical work includes various electrical devices, such as, call bells, starting gongs, fire alarms, directional signs and lighting, train indicators and wiring for pumps, fans, heaters and public address system.

Track Work

The track work for this extension will be of similar construction as in the present Washington Street Tunnel. The track will be Standard Gauge, A.R.A. Type B 100# track rails and 85# electric conductor third rail.

All track will be laid on wood cross-ties with crushed stone ballast in the subway section and along the open right-of-way. On the elevated section the cross-ties will rest on steel girders or trusses supported by traverse steel bents.

All curves of 3000 foot C.R. or less will have guard rails of 85# restraining rails on the inside of the curves to take the thrust. Curves of less than 3000 foot C.R. will have an easement

at each end of the curve wherever possible.

At the outbound end of each station an emergency cross-over is placed for turning trains back whenever required. These cross-overs will consist of two single points and an unbroken main line frog.

Estimates of Cost

Estimates of cost have been prepared for the work involved in the "Legislative" Route and in the "Alternate" Route. A breakdown of the cost estimates, based on an accurate take-off of quantities and unit prices which are, in our opinion, representative of present day costs, is included herein.

The estimates are divided into the four contract sections recommended hereinbefore. Summaries of the detailed estimates are also submitted.

at each end of the curve wherever possible.

At the outbound end of each station an emergency

Estimates of Cost

The estimates are divided into the four contract sections

are also submitted.

ESTIMATE

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
1	Borings and Test Pits			L.S.	$ 4,500
	II. RAPID TRANSIT CONSTRUCTION				
	A. BOYLSTON ST. CONNECTION				
2	Structural Steel (Rolled)	170	Ton	$275.00	$46,750
3	" " (Temp.)	54	Ton	180.00	9,720
4	Concrete Masonry	1,640	C. Y.	37.00	60,680
5	Reinforcing Steel	157,000	Lbs.	0.11	17,270
6	Demolition of Concrete	952	C. Y.	55.00	52,360
7	Removal of Structural Steel	81	Ton	160.00	12,960
8	Track Removal	320	L. F.	1.00	320
9	Earth Excavation	4,320	C. Y.	10.75	46,440
10	Waterproofing - 6 Ply	373	S. Y.	5.20	1,940
11	" - 4 "	1,710	S. Y.	3.50	5,985
					$254,425
	B. DORE ST. TO OAK ST. (OPEN CUT)				
12	Excavation - 0' to 10'	9,710	C. Y.	$ 8.75	$84,963
13	" - over 10'	20,670	C. Y.	10.75	222,203
14	Concrete Masonry	6,210	C. Y.	37.00	229,770
15	Reinforcing Steel	819,000	Lbs.	0.11	90,090
16	Decking - Roadway	3,410	S. Y.	30.00	102,300
17	Restoration - Roadway	3,410	S. Y.	8.00	27,280
18	Waterproofing - 6 Ply	4,210	S. Y.	5.20	21,892
19	" - 4 "	3,340	S. Y.	3.50	11,690
20	" - 3 "	1,590	S. Y.	2.70	4,293
					$794,481
	C. COMPTON ST. TO DOVER ST. (UNDER BUILDINGS				
21	Excavation - 0' to 10'	5,430	C. Y.	$ 8.75	$47,512
22	" - over 10'	10,450	C. Y.	10.75	112,337
23	Concrete Masonry	4,440	C. Y.	37.00	164,280
24	Reinforcing Steel	524,000	Lbs.	0.11	57,640
25	Structural Steel (Rolled)	506	Ton	275.00	139,150
26	Beam Wrapping	1,500	Lbs.	0.65	975
27	Decking - Roadway	266	S. Y.	30.00	7,980
28	" - Sidewalk	160	S. Y.	20.00	3,200

ESTIMATE

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
1	Borings and Test Pits		L.S.		$ 4,500
	II. RAPID TRANSIT CONSTRUCTION				
	A. BOYLSTON ST. CONNECTION				
2	Structural Steel (Rolled)	170	Ton	$275.00	$46,750
3	" " (Temp.)	54	Ton	180.00	9,720
4	Concrete Masonry	1,640	C. Y.	37.00	60,680
5	Reinforcing Steel	157,000	Lbs.	0.11	17,270
6	Demolition of Concrete	952	C. Y.	55.00	52,360
7	Removal of Structural Steel	81	Ton	160.00	12,960
8	Track Removal	320	L. F.	1.00	320
9	Earth Excavation	4,320	C. Y.	10.75	46,440
10	Waterproofing - 6 Ply	373	S. Y.	5.80	1,940
11	" - 4 "	1,710	S. Y.	3.50	5,985
					$254,425
	B. DOANE ST. TO OAK ST. (OPEN CUT)				
12	Excavation - 0' to 10'	9,710	C. Y.	$ 8.75	$84,963
13	" - over 10'	20,670	C. Y.	10.75	222,203
14	Concrete Masonry	6,210	C. Y.	37.00	229,770
15	Reinforcing Steel	819,000	Lbs.	0.11	90,090
16	Decking - Roadway	3,410	S. Y.	30.00	102,300
17	Restoration - Roadway	3,410	S. Y.	8.00	27,280
18	Waterproofing - 6 Ply	4,210	S. Y.	5.50	23,155
19	" - 4 "	3,340	S. Y.	3.50	11,690
20	" - 3 "	1,590	S. Y.	2.70	4,293
					$794,481
	C. COMMERCIAL ST. TO DOVER ST. (UNDER BUILDINGS)				
21	Excavation - 0' to 10'	5,430	C. Y.	$ 8.75	$47,512
22	" - over 10'	10,450	C. Y.	10.75	112,337
23	Concrete Masonry	4,440	C. Y.	37.00	164,280
24	Reinforcing Steel	524,000	Lbs.	0.11	57,640
25	Structural Steel (Rolled)	506	Ton	275.00	139,150
26	Beam Wrapping	1,500	Lbs.	0.65	975
27	Decking - Roadway	266	S. Y.	30.00	7,980
28	" - Sidewalk	160	S. Y.	20.00	3,200

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
29	Restoration - Roadway	266	S. Y.	8.00	2,128
30	" - Sidewalk	160	S. Y.	9.00	1,440
31	Waterproofing - 6 Ply	2,840	S. Y.	5.20	14,768
32	" - 4 "	1,470	S. Y.	3.50	5,145
33	" - 3 "	830	S. Y.	2.70	2,241
					$558,796

III. UNDERPINNING

A. COBB ST. TO DOVER ST. (BUILDINGS)

34	Concrete Masonry	830	C. Y.	$ 37.00	$30,710
35	Structural Steel (Temp)	242	Ton	180.00	43,560
36	" " (Rolled)	43	Ton	275.00	11,825
37	Demolition of Concrete	350	C. Y.	55.00	19,250
38	Timber	217	M. B. M.	200.00	43,400
39	Maintenance of Buildings			L. S.	10,000
					$158,745

IV. VENTILATION

40	Grating	1,500	S. F.	$ 4.50	$ 6,750
41	Concrete Masonry	420	C. Y.	37.00	15,540
42	Reinforcing Steel	13,000	Lbs.	0.11	1,430
43	Fan Chambers and Equipment	2	Ea.	17,500.00	35,000
					$58,720

V. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

1. Boylston St. to Warrenton St.

44	12" Main	963	L. F.	$ 5.00	$ 4,815
45	16" "	1,183	L. F.	6.00	7,098
46	20" "	53	L. F.	7.00	371
					$12,284

2. Warrenton St. to Dover St.

47	6" Main	386	L. F.	$ 3.00	$ 1,158
48	8" "	84	L. F.	3.50	294
49	10" "	195	L. F.	4.00	780
50	12" "	126	L. F.	5.00	630

No.	Item	Quantity	Unit	Unit Price	Amount
29	Excavation - Roadway	640	C. Y.	$ 2.00	$ 1,280
30	" - Sidewalk	180	C. Y.	1.50	270
31	Macadamizing - 6 Sty	2,640	Sq. Yd.	3.00	7,920
32	" - 4 "	1,470	C. Y.	2.50	3,675
33	" - 3 "	830	C. Y.	2.70	2,241

III. UNDERPINNING

A. COOK ST. TO DOVER ST.

MULLEN BLOCK

34	Concrete Masonry	830	C. Y.	$ 37.00	$30,710
35	Structural Steel (Temp)	642	Tns	140.00	89,880
36	" (Relief)	81	Tns	170.00	13,770
37	Demolition of Concrete	440	C. Y.	8.00	3,520
38	Timber	217	M. B. M.	200.00	43,400
39	Maintenance of Buildings		L. S.		10,000

IV. VENTILATION

40	Grating	1,500	S. F.	$ 4.50	$ 6,750
41	Concrete Masonry	420	C. Y.	37.00	15,540
42	Reinforcing Steel	13,000	Lbs.	0.11	1,430
43	Fan Chambers and Equipment 2		Ea.	17,500.00	35,000

V. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

1. Replacing 2" in Warrington

44	12" Main	703	L. F.	$ 5.00	$ 4,015
45	16" "	1,183	L. F.	6.00	7,098
46	20" "	53	L. F.	7.00	371

2. Warrington St. to Cooper St.

47	6" Main	185	L. F.	$ 3.00	$ 1,158
48	8" "	84	L. F.	3.50	294
49	10" "	172	L. F.	4.00	780
50	12" "	112	L. F.	5.00	630

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
51	16" Main	195	L.F.	6.00	1,170
52	Water Manholes	3	Ea.	200.00	600
					$ 4,632
	B. SEWERS				
	1. Boylston St. to Warrenton St.				
53	20" Pipe	705	L.F.	$ 12.00	$ 8,460
54	30" "	240	L.F.	15.00	3,600
55	Supports for 12" Pipe	280	L.F.	8.50	2,380
56	" " 20" "	240	L.F.	12.00	2,880
57	Sewer Manholes	8	Ea.	200.00	1,600
					$18,920
	2. Warrenton St. to Dover St.				
58	12" Pipe	40	L.F.	$ 8.50	$ 340
59	33" "	200	L.F.	16.00	3,200
60	Supports for 12" x 18" Brick	40	L.F.	10.00	400
61	" " 12" x 16" "	40	L.F.	10.00	400
62	" " 10" Pipe	40	L.F.	8.00	320
63	" " 12" "	40	L.F.	8.50	340
					$ 5,000
	C. SIPHONS				
	1. Boylston St. to Warrenton St.				
64	At Dore St. - 30"	80	L.F.	$ 61.00	$ 4,880
	D. FIRE MAINS				
	1. Boylston St. to Warrenton St.				
65	20" Pipe	995	L.F.	$ 17.50	$17,413
	E. M.T.A. HIGH TENSION DUCT				
	1. Warrenton St. to Dover St.				
66	Duct	420	L.F.	$ 2.20	$ 924

No.	Item	Quantity	Unit	Unit Price	Amount
#1	16" Main	195	L. F.	6.00	1,170
#2	Water Manholes	3	Ea.	200.00	600
					$ 4,632

B. SEWERS

1. Boylston St. to Warrenton St.

#4	20" Pipe	705	L. F.	$ 12.00	$ 8,460
#4	30" "	240	L. F.	15.00	3,600
#5	Supports for 12" Pipe	280	L. F.	8.50	2,380
#6	" " 20" "	240	L. F.	12.00	2,880
#7	Sewer Manholes	8	Ea.	200.00	1,600
					$18,920

2. Warrenton St. to Dover St.

#8	12" Pipe	40	L. F.	$ 8.50	$ 340
#9	33" "	200	L. F.	16.00	3,200
#0	Supports for 12" x 18" Brick	40	L. F.	10.00	400
#1	" " 12" x 16" "	40	L. F.	10.00	400
#2	" " 10" Pipe	40	L. F.	8.00	320
#3	" " 12" "	40	L. F.	8.50	340
					$ 5,000

C. SIPHONS

1. Boylston St. to Warrenton St.

#4	At Dore St. - 30"	80	L. F.	$ 61.00	$ 4,880

D. WATER MAINS

1. Boylston St. to Warrenton St.

#5	20" Pipe	995	L. F.	$ 17.50	$17,413

E. M. T. A. HIGH TENSION DUCT

1. Warrenton St. to Dover St.

#6	Duct	420	L. F.	$ 2.20	$ 924

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
	VI. EQUIPMENT				
	A. PUMPS				
67	1. Corning St.	1	Ea.	$10,000.00	$10,000
	VII. MAINTENANCE OF TRAFFIC				
68	1. Flagmen at Boylston St.	2	Yrs.	$12,000.00	$24,000
	VIII. CONSTRUCTION - OAK ST. TO COMPTON ST.				
	A. OPEN CUT METHOD UNDER N.Y., N.H. & H. & B. & A. R.R. TRACKS				
	1. Rapid Transit Construction				
69	Excavation - 0' to 10'	15,680	C.Y.	$ 8.75	$137,200
70	" - over 10'	40,000	C.Y.	10.75	430,000
71	Concrete Masonry	12,560	C.Y.	37.00	464,720
72	Reinforcing Steel	1,494,500	Lbs.	0.11	164,395
73	Structural Steel (Rolled)	1,313	Ton	275.00	361,075
74	Beam Wrapping	4,120	Lbs.	0.65	2,678
75	Decking - Roadway	1,510	S.Y.	30.00	45,300
76	" - Sidewalk	246	S.Y.	20.00	4,920
77	Restoration - Roadway	1,510	S.Y.	8.00	12,080
78	" - Sidewalk	246	S.Y.	9.00	2,214
79	Waterproofing - 6 Ply	9,050	S.Y.	5.20	47,060
80	" - 4 "	4,170	S.Y.	3.50	14,595
81	" - 3 "	1,690	S.Y.	2.70	4,563
					$1,690,800
	2. Underpinning Buildings				
82	Concrete Masonry	470	C.Y.	$ 37.00	$17,390
83	Structural Steel (Temp.)	136	Ton	180.00	24,480
84	" " (Rolled)	25	Ton	275.00	6,875
85	Demolition of Concrete	200	C.Y.	55.00	11,000
86	Timber	124	M.B.M.	200.00	24,800
87	Maintenance of Buildings			L.S.	15,000
					$99,545
	3. Underpinning N.Y., N.H. & H. & B. & A. R.R. Tracks				
88	Excavation	6,200	C.Y.	$ 10.75	$66,650
89	Structural Steel (Temp.)	215	Ton	180.00	38,700

No.	Item	Quantity	Unit	Unit Price	Amount
	VI. EQUIPMENT				
	A. PUMPS				
67	1. Corning St.	1	Ea.	$10,000.00	$10,000
	VII. MAINTENANCE OF TRAFFIC				
68	1. Flagmen at Boylston St.	2	Yrs.	$12,000.00	$24,000
	VIII. CONSTRUCTION - OAK ST. TO COMPTON ST.				
	A. OPEN CUT METHOD UNDER N. Y., N. H. & H. & B. & A. R. R. TRACKS				
	1. Rapid Transit Construction				
69	Excavation - 0' to 10'	15,680	C. Y.	$ 8.75	$137,200
70	" - over 10'	40,000	C. Y.	10.75	430,000
71	Concrete Masonry	12,560	C. Y.	37.00	464,720
72	Reinforcing Steel	1,494,500	Lbs.	0.11	164,395
73	Structural Steel (Rolled)	1,313	Ton	275.00	361,075
74	Beam Wrapping	4,120	Lbs.	0.65	2,678
75	Decking - Roadway	1,510	S. Y.	30.00	45,300
76	" - Sidewalk	246	S. Y.	20.00	4,920
77	Restoration - Roadway	1,510	S. Y.	8.00	12,080
78	" - Sidewalk	246	S. Y.	9.00	2,214
79	Waterproofing - 6 Ply	9,050	S. Y.	5.20	47,060
80	" - 4 "	4,170	S. Y.	3.50	14,595
81	" - 3 "	1,690	S. Y.	2.70	4,563
					$1,690,800
	2. Underpinning Buildings				
82	Concrete Masonry	470	C. Y.	$ 37.00	$17,390
83	Structural Steel (Temp.)	136	Ton	180.00	24,480
84	" " (Rolled)	25	Ton	275.00	6,875
85	Demolition of Concrete	200	C. Y.	55.00	11,000
86	Timber	124	M. B. M.	200.00	24,800
87	Maintenance of Buildings		L. S.		15,000
					$99,545
	3. Underpinning N. Y., N. H. & H. & B. & A. R. R. Tracks				
88	Excavation	6,200	C. Y.	$ 10.75	$66,650
89	Structural Steel (Temp.)	314	Ton	180.00	56,520

EXISTING BOYLSTON STATION TO DOVER STREET

No.	Item	Quantity	Unit	Unit Price	Amount
90	Timber	60	M.B.M.	200.00	12,000
91	Timber Piles	9,600	L.F.	2.50	24,000
					$141,350

4. Underpinning Retaining Walls

92	Structural Steel (Built-up)	27	Ton	$425.00	$11,475
93	" " (Temp.)	11	Ton	180.00	1,980
94	Temporary Steel Piles	1,514	L.F.	12.00	18,168
					$31,623

B. SHIELD DRIVEN TUNNEL ALTERNATE UNDER N.Y. N.H. & H. & B. & A. R.R TRACKS

1. Tunnel

95	Tunnel Excavation	15,750	C.Y.	$ 50.00	$787,500
96	C.I. Tunnel Lining	4,708	Ton	198.00	932,184
97	High Tensile Steel Bolts	50,255	Ea.	1.25	62,819
98	Gravel Packing	1,060	C.Y.	25.00	26,500
99	Grout Outside C.I. Lining	2,120	Bbl.	25.00	53,000
100	Concrete Inside " "	2,272	C.Y.	60.00	136,320
101	3 1/2 Vit. Clay Ducts	14,110	L.F.	0.75	10,583
102	Reinforcing Steel in Duct Covers	4	Ton	400.00	1,600
103	Splicing Chambers	12	Ea.	400.00	4,800
104	Hand Rail	1,420	L.F.	1.25	1,775
105	Electrolysis Bonds	2	Ea.	500.00	1,000
106	Sump (Between Tubes)			L.S.	20,000
					$2,038,081

2. Transition Subway Section

107	Excavation - 0' to 10'	6,750	C.Y.	$ 8.75	$59,063
108	" - over 10'	17,350	C.Y.	10.75	186,513
109	Concrete Masonry	5,340	C.Y.	37.00	197,580
110	Reinforcing Steel	643,300	Lbs.	0.11	70,763
111	Structural Steel	492	Ton	275.00	135,300
112	Beam Wrapping	1,700	Lbs.	0.65	1,105
113	Waterproofing - 6 Ply	4,280	S.Y.	5.20	22,256
114	" - 4 "	1,970	S.Y.	3.50	6,895
115	" - 3 "	770	S.Y.	2.70	2,079
					$681,554

No.	Item	Quantity	Unit	Unit Price	Amount
90	Timber	60	M.B.M.	200.00	
91	Timber Piles	9,600	L.F.	2.50	

4. Underpinning Retaining Walls

92	Structural Steel (Built-up)	27	Ton	$425.00	
93	" " (Temp.)	11	Ton	180.00	
94	Temporary Steel Piles	1,514	L.F.	12.00	

N. H. & H. B. & A. R. R. TRACKS

1. Tunnel

95	Tunnel Excavation	15,750	C.Y.	$ 50.00	
96	C.I. Tunnel Lining	4,708	Ton	198.00	
97	High Tensile Steel Bolts	50,255	Lbs.	1.25	
98	Gravel Packing	1,060	C.Y.	25.00	
99	Grout Outside C.I. Lining	2,120	Bbl.	25.00	
100	Concrete Inside " "	2,272	C.Y.	60.00	
101	3 1/2 Vit. Clay Ducts	14,110	L.F.	0.75	
102	Reinforcing Steel in Duct				
	Curves	4	Ton	400.00	
103	Splicing Chambers	12	Ea.	400.00	
104	Hand Rail	1,420	L.F.	1.25	
105	Electrolysis Bonds	2	Ea.	500.00	
106	Sump (Between Tubes)		L.S.		

2. Transition Subway Section

107	Excavation - 0' to 10'	6,750	C.Y.	$ 6.75	
108	" - over 10'	17,350	C.Y.	10.75	
109	Concrete Masonry	4,340	C.Y.	37.00	
110	Reinforcing Steel	641,300	Lbs.	0.11	
111	Structural Steel	142	Ton	275.00	
112	Beam Wrapping	1,700	Lbs.	0.65	
113	Waterproofing - 4 Ply	1,100	S.Y.	5.20	
114	"	1,470	S.Y.	3.50	
115	" - 3 "	770	S.Y.	2.70	

EXISTING BOYLSTON STATION TO DOVER STREET

I. Including Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Summary Item Nos. 1-68	$1,927,720
Summary Item Nos. 69-94	1,963,318
Construction Cost	$3,891,038
Contingencies - 10%	389,104
	4,280,142
Engineering & Administration 10%	428,014
	$4,708,156*

II. Including Shield Driven Tunnel Alternate Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Summary Item Nos. 1-68	$1,927,720
Summary Item Nos. 95-115	2,719,635
Construction Cost	$4,647,355
Contingencies - 10%	464,735
	5,112,090
Engineering & Administration 10%	511,209
	$5,623,299*

* Does not include cost of: Track Work, Power, Signals and Lighting, Land Damages, Demolition of Existing Washington St. Elevated and Interest During Construction

ESTIMATE

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
116	Borings and Test Pits			L.S.	$ 9,000
	II. RAPID TRANSIT CONSTRUCTION				
	A. DOVER ST. TO LENOX ST.				
117	Excavation - 0' to 10'	43,320	C.Y.	$ 8.75	$379,050
118	" - over 10'	96,010	C.Y.	10.75	1,032,108
119	Concrete Masonry	29,310	C.Y.	37.00	1,084,470
120	Reinforcing Steel	3,970,000	Lbs.	0.11	436,700
121	Decking - Roadway	16,540	S.Y.	30.00	496,200
122	Restoration - Roadway	16,540	S.Y.	8.00	132,320
123	Waterproofing - 6 Ply	20,390	S.Y.	5.20	106,028
124	" - 4 "	16,170	S.Y.	3.50	56,595
125	" - 3 "	7,710	S.Y.	2.70	20,817
					$3,744,288
	B. UNION PARK STREET STATION				
126	Excavation - 0 to 10'	9,260	C.Y.	$ 8.75	$81,025
127	" - over 10'	26,390	C.Y.	10.75	283,693
128	Concrete Masonry	6,280	C.Y.	37.00	232,360
129	Reinforcing Steel	63,700	Lbs.	0.11	7,007
130	Structural Steel (Rolled)	976	Ton	275.00	268,400
131	Beam Wrapping	1,400	Lbs.	0.65	910
132	Decking - Roadway	1,778	S.Y.	30.00	53,340
133	" - Sidewalk	889	S.Y.	20.00	17,780
134	Restoration - Roadway	1,778	S.Y.	8.00	14,224
135	" - Sidewalk	889	S.Y.	9.00	8,001
136	Waterproofing - 6 Ply	3,700	S.Y.	5.20	19,240
137	" - 4 "	4,250	S.Y.	3.50	14,875
138	Concrete Finish	67,040	S.F.	0.30	20,112
139	Tile	15,360	S.F.	2.80	43,008
140	Railing	506	L.F.	6.00	3,036
141	Escalator			L.S.	47,000
					$1,114,011
	C. MASSACHUSETTS AVENUE STATION				
142	Excavation - 0' to 10'	9,780	C.Y.	$ 8.75	$85,575
143	" - over 10'	26,800	C.Y.	10.75	288,100
144	Concrete Masonry	6,840	C.Y.	37.00	253,080

ESTIMATE

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
116	Borings and Test Pits		L.S.		$ 9,000
	II. RAPID TRANSIT CONSTRUCTION				
	A. DOVER ST. TO LENOX ST.				
117	Excavation - 0' to 10'	43,320	C.Y.	$ 8.75	$379,050
118	" - over 10'	96,010	C.Y.	10.75	1,032,108
119	Concrete Masonry	29,310	C.Y.	37.00	1,084,470
120	Reinforcing Steel	3,970,000	Lbs.	0.11	436,700
121	Decking - Roadway	16,540	S.Y.	30.00	496,200
122	Restoration - Roadway	16,540	S.Y.	8.00	132,320
123	Waterproofing - 4 Ply	20,370	S.Y.	5.20	105,924
124	" - 4 "	16,170	S.Y.	3.50	56,595
125	" - 3 "	7,710	S.Y.	2.70	20,817
					$3,744,288
	B. UNION PARK STREET STATION				
126	Excavation - 0 to 10'	9,260	C.Y.	$ 8.75	$81,025
127	" - over 10'	26,390	C.Y.	10.75	283,693
128	Concrete Masonry	6,280	C.Y.	37.00	232,360
129	Reinforcing Steel	63,700	Lbs.	0.11	7,007
130	Structural Steel (Rolled)	976	Tons	275.00	268,400
131	Beam Wrapping	1,400	Lbs.	0.65	910
132	Decking - Roadway	1,776	S.Y.	10.00	17,760
133	" - Sidewalk	889	S.Y.	20.00	17,780
134	Restoration - Roadway	1,778	S.Y.	8.00	14,224
135	" - Sidewalk	889	S.Y.	9.00	8,001
136	Waterproofing - 4 Ply	3,700	S.Y.	5.20	19,240
137	" - 4 "	4,250	S.Y.	3.50	14,875
138	Concrete Finish	47,848	S.F.	0.30	10,114
139	Tile	15,360	S.F.	2.80	43,008
140	Railing	506	L.F.	6.00	3,036
141	Escalator		L.S.		47,000
					$1,114,011
	C. MASSACHUSETTS AVENUE STATION				
142	Excavation - 0' to 10'	9,780	C.Y.	$ 8.75	$85,575
143	" - over 10'	26,800	C.Y.	10.75	288,100
144	Concrete Masonry	6,840	C.Y.	37.00	253,080

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
145	Reinforcing Steel	77,500	Lbs.	0.11	8,525
146	Structural Steel(Rolled)	962	Ton	275.00	264,550
147	Beam Wrapping	1,400	Lbs.	0.65	910
148	Decking- Roadway	1,778	S. Y.	30.00	53,340
149	" - Sidewalk	889	S. Y.	20.00	17,780
150	Restoration - Roadway	1,778	S. Y.	8.00	14,224
151	" - Sidewalk	889	S. Y.	9.00	8,001
152	Waterproofing - 6 Ply	3,670	S. Y.	5.20	19,084
153	" - 4 Ply	4,550	S. Y.	3.50	15,925
154	Concrete Finish	67,530	S. F.	0.30	20,259
155	Tile	15,980	S. F.	2.80	44,744
156	Railing	506	L. F.	6.00	3,036
					$1,097,133

III. VENTILATION

157	Grating	6,500	S. F.	$ 4.50	$29,250
158	Concrete Masonry	1,840	C. Y.	37.00	68,080
159	Reinforcing Steel	58,000	Lbs.	0.11	6,380
160	Fan Chambers & Equipment	1	Ea.	17,500.00	17,500
					$121,210

IV. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

1. Dover St. to Lenox St.

161	6" Main	920	L. F.	$ 3.00	$ 2,760
162	8" "	310	L. F.	3.50	1,085
163	10" "	290	L. F.	4.00	1,160
164	12" "	5,000	L. F.	5.00	25,000
165	16" "	325	L. F.	6.00	1,950
166	20" "	339	L. F.	7.00	2,373
167	30" "	140	L. F.	15.00	2,100
					$36,428

B. SEWERS

1. Dover St. to Lenox St.

168	12" Pipe	222	L. F.	$ 8.50	$ 1,887
169	15" "	1,565	L. F.	9.50	14,868
170	18" "	610	L. F.	11.00	6,710
171	21" "	3,640	L. F.	12.00	43,680

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
145	Reinforcing Steel	77,500	Lbs.	0.11	8,525
146	Structural Steel(Rolled)	962	Ton	275.00	264,550
147	Beam Wrapping	1,400	Lbs.	0.65	910
148	Decking- Roadway	1,778	S.Y.	30.00	53,340
149	" - Sidewalk	889	S.Y.	20.00	17,780
150	Restoration - Roadway	1,778	S.Y.	8.00	14,224
151	" - Sidewalk	889	S.Y.	9.00	8,001
153	" - 4 Ply	4,550	S.Y.	3.50	15,925
154	Concrete Finish	67,530	S.F.	0.30	20,259
155	Tile	15,980	S.F.	2.80	44,744
156	Railing	506	L.F.	6.00	3,036
					$1,097,133

III. VENTILATION

157	Grating	6,500	S.F.	$ 4.50	$29,250
158	Concrete Masonry	1,840	C.Y.	37.00	68,080
159	Reinforcing Steel	58,000	Lbs.	0.11	6,380
					$103,710

IV. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

161	6" Main	920	L.F.	$ 3.00	$ 2,760
162	8" "	310	L.F.	3.50	1,085
163	10" "	290	L.F.	4.00	1,160
164	12" "	5,000	L.F.	5.00	25,000
165	16" "	325	L.F.	6.00	1,950
166	20" "	339	L.F.	7.00	2,373
167	30" "	140	L.F.	15.00	2,100
					$ 36,428

B. SEWERS

168	12" Pipe	222	L.F.	$ 8.50	$ 1,887
169	15" "	1,565	L.F.	9.50	14,868
170	18" "	610	L.F.	11.00	6,710
171	21" "	3,640	L.F.	12.00	43,680

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
172	24" Pipe	1,285	L.F.	13.00	16,705
173	30" "	250	L.F.	15.00	3,750
174	72" "	40	L.F.	30.00	1,200
175	Sewer Manholes	45	Ea.	200.00	9,000
176	" "	10	Ea.	300.00	3,000
					$100,800

C. SIPHONS

1. Dover St. To Lenox St.

177	At West Concord St. -8'x5'	80	L.F.	$130.00	$10,400
178	At Camden St. -8'-3"x8'-5"	80	L.F.	200.00	16,000
					$26,400

D. M.T.A. HIGH TENSION DUCT

1. Dover St. to Lenox St.

179	Duct	727	L.F.	$ 2.20	$ 1,600
180	Manholes	8	Ea.	200.00	1,600
					$ 3,200

V. EQUIPMENT

A. PUMPS

181	1. Union Park St.	1	Ea.	$2,000.00	$ 2,000
182	2. Massachusetts Ave.	1	Ea.	$2,000.00	$ 2,000

B. STATION EQUIPMENT

183	1. Union Park St.			L.S.	$22,000
184	2. Massachusetts Ave.			L.S.	$22,000

Construction Cost - Summary Item Nos. 116-184	$6,300,470
Contingencies 10%	630,047
	6,930,517
Engineering & Administration 10%	693,052
	$7,623,569*

* Does not include cost of: Track work, Power, Signals and Lighting, Land damages, Demolition of Existing Washington St. Elevated and Interest During Construction

DOVER ST. TO LENOX ST.

No.	Item	Quantity	Unit	Unit Price	Amount
172	24" Pipe	1,285	L.F.	13.00	16,705
173	30" "	250	L.F.	15.00	3,750
174	72" "	40	L.F.	30.00	1,200
175	Sewer Manholes	45	Ea.	200.00	9,000
176	" "	10	Ea.	300.00	3,000
					$100,800

C. [illegible]

1. Dover St. To Lenox St.

177	At West Concord St. -8'x5'	80	L.F.	$130.00	$10,400
178	At Camden St. -8'-3"x8'-5"	80	L.F.	200.00	16,000
					$26,400

D. M.T.A. HIGH TENSION DUCT

1. Dover St. to Lenox St.

179	Duct	727	L.F.	$ 2.20	$ 1,600
180	Manholes	8	Ea.	200.00	1,600
					$ 3,200

V. EQUIPMENT

A. [illegible]

181	1. Union Park St.	1	Ea.	$2,000.00	$ 2,000
182	2. Massachusetts Ave.	1	Ea.	$2,000.00	$ 2,000

B. STATION EQUIPMENT

183	1. Union Park St.		L.S.	$22,000
184	2. Massachusetts Ave.		L.S.	$22,000

Construction Cost - Summary Item Nos. 116-184 $6,300,470
Contingencies 10% 630,047
6,930,517

Engineering & Administration 10% 693,052
[illegible]

* Does not include cost of: Track work, Power, Signals and Lighting, Land damages, Demolition of Existing Waterlines St. Electrical and Interest During Construction

ESTIMATE

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
185	Borings and Test Pits			L.S.	$15,750
	II. RAPID TRANSIT CONSTRUCTION				
	A. ST. JAMES ST. TO KINGSBURY ST. (OPEN CUT)				
186	Excavation - 0' to 10'	24,450	C.Y.	$ 8.75	$213,938
187	" - over 10'	21,970	C.Y.	10.75	236,177
188	" - Conglomerate	17,570	C.Y.	12.00	210,840
189	Concrete Masonry	13,500	C.Y.	37.00	499,500
190	Reinforcing Steel	2,100,000	Lbs.	0.11	231,000
191	Decking - Roadway	8,750	S.Y.	30.00	262,500
192	Restoration - Roadway	8,750	S.Y.	8.00	70,000
193	Waterproofing-6 Ply	10,790	S.Y.	5.20	56,108
194	" -4 "	8,560	S.Y.	3.50	29,960
195	" -3 "	4,080	S.Y.	2.70	11,016
					$1,821,039
	B. KINGSBURY ST. TO INCLINE(UNDER BUILDINGS)				
196	Excavation - 0' to 10'	19,570	C.Y.	$ 8.75	$171,238
197	" - over 10'	15,450	C.Y.	10.75	166,087
198	" - Conglomerate	17550	C.Y.	12.00	210,600
199	Concrete Masonry	16,030	C.Y.	37.00	593,110
200	Reinforcing Steel	1,890,000	Lbs.	0.11	207,900
201	Structural Steel (Rolled)	1,824	Ton	275.00	501,600
202	Beam Wrapping	5,100	Lbs.	0.65	3,315
203	Decking - Roadway	998	S.Y.	30.00	29,940
204	Decking - Sidewalk	487	S.Y.	20.00	9,740
205	Restoration - Roadway	998	S.Y.	8.00	7,984
206	" - Sidewalk	487	S.Y.	9.00	4,383
207	Waterproofing - 6 Ply	10,240	S.Y.	5.20	53,248
208	" - 4 "	5,280	S.Y.	3.50	18,480
209	" - 3 "	3,000	S.Y.	2.70	8,100
					$1,985,725
	C. INCLINE AT RITCHIE ST.				
210	Excavation - Conglomerate	3,790	C.Y.	$ 12.00	$45,480
211	Concrete Masonry	520	C.Y.	37.00	19,240

ESTIMATE

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
185	Borings and Test Pits		L. S.		$15,750
	II. RAPID TRANSIT CONSTRUCTION				
	A. ST. JAMES ST. TO KINGSBURY ST. (OPEN CUT)				
186	Excavation - 0' to 10'	24,450	C. Y.	$ 8.75	$213,938
187	" - over 10'	21,970	C. Y.	10.75	236,177
188	" - Conglomerate	17,570	C. Y.	12.00	210,840
189	Concrete Masonry	13,500	C. Y.	37.00	499,500
190	Reinforcing Steel	2,100,000	Lbs.	0.11	231,000
191	Decking - Roadway	8,750	S. Y.	30.00	262,500
192	Restoration - Roadway	8,750	S. Y.	8.00	70,000
193	Waterproofing-6 Ply	10,740	S. Y.	9.20	98,808
194	" -4 "	8,560	S. Y.	3.50	29,960
195	" -3 "	4,080	S. Y.	2.70	11,016
					$1,821,039
	B. KINGSBURY ST. TO INCLINE(UNDER BUILDING)				
196	Excavation - 0' to 10'	19,570	C. Y.	$ 8.75	$171,238
197	" - over 10'	15,450	C. Y.	10.75	166,087
198	" - Conglomerate	7550	C. Y.	12.00	90,600
199	Concrete Masonry	14,210	C. Y.	41.00	582,610
200	Reinforcing Steel	1,890,000	Lbs.	0.11	207,900
201	Structural Steel (Rolled)	4,824	Tons	275.00	1,326,600
202	Beam Wrapping	5,100	Lbs.	0.65	3,315
203	Decking - Roadway	998	S. Y.	30.00	29,940
204	Decking - Sidewalk	487	S. Y.	20.00	9,740
205	Restoration - Roadway	998	S. Y.	8.00	7,984
206	" - Sidewalk	487	S. Y.	9.00	4,383
207	Waterproofing - 5 Ply	10,440	S. Y.	3.20	33,408
208	" - 4 "	5,280	S. Y.	3.50	18,480
209	" - 3 "	3,000	S. Y.	2.70	8,100
					$1,985,725
	C. INCLINE AT KITCHENER ST.				
210	Excavation - Conglomerate	1,750	C. Y.	$ 12.00	$ 21,000
211	Concrete Masonry	520	C. Y.	37.00	19,240

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
212	Reinforcing Steel	20,520	Lbs.	0.11	2,257
					$66,977

III. UNDERPINNINGS

A. VALENTINE ST. TO MARCELLA ST. (BUILDINGS)

213	Concrete Masonry	480	C.Y.	$ 37.00	$17,760
214	Structural Steel (Temp)	139	Ton	180.00	25,020
215	" " (Rolled)	25	Ton	275.00	6,875
216	Demolition of Concrete	200	C.Y.	55.00	11,000
217	Timber	128	M.B.M.	200.00	25,600
218	Maintenance of Buildings			L.S.	6,000
					$92,255

B. ST. JAMES ST. TO VALENTINE ST. (ELEVATED COLUMNS)

219	Excavation	2,100	C.Y.	$ 8.75	$18,375
220	Concrete Masonry	170	C.Y.	37.00	6,290
221	Structural Steel (Temp)	714	Ton	180.00	128,520
222	Demolition of Concrete	1,010	C.Y.	55.00	55,550
223	Timber	168	M.B.M.	200.00	33,600
224	Pipe Piles	4,200	L.F.	15.00	63,000
					$305,335

IV. VENTILATION

225	Grating	6,000	S.F.	$ 4.50	$27,000
226	Concrete Masonry	1,690	C.Y.	37.00	62,530
227	Reinforcing Steel	54,000	Lbs.	0.11	5,940
228	Fan Chambers & Equipment	4	Ea.	17,500.00	70,000
					$165,470

V. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

1. St. James St. to Valentine St.

229	4" Main	640	L.F.	$ 2.50	$ 1,600
230	6" "	60	L.F.	3.00	180
231	8" "	42	L.F.	3.50	147
232	12" "	2,785	L.F.	5.00	13,925

No.	Item	Quantity	Unit	Unit Price	Amount
212	Reinforcing Steel	20,520	Lbs.	0.11	2,257

III. [illegible]

A. VALENTINE ST. TO MARCELLA ST.
(ABUTMENTS)

213	Concrete Masonry	480	C.Y.	$ 37.00	$17,760
214	Structural Steel (Temp)	139	Ton	180.00	25,020
215	" " (Rolled)	25	Ton	275.00	6,875
216	Demolition of Concrete	200	C.Y.	55.00	11,000
217	Timber	[illegible]	[illegible]	[illegible]	[illegible]
218	Maintenance of Buildings		L.S.		6,000
					$92,255

B. ST. JAMES ST. TO VALENTINE ST.
(ELEVATED COLUMNS)

219	Excavation	2,100	C.Y.	$ 8.75	$18,375
220	Concrete Masonry	170	C.Y.	37.00	6,290
221	Structural Steel (Temp)	714	Ton	180.00	[illegible]
222	Demolition of Concrete	1,010	C.Y.	55.00	55,550
223	Timber	168	M.B.M.	200.00	33,600
224	Pipe Piles	4,200	L.F.	15.00	63,000
					$305,335

IV. VENTILATION

225	Grating	6,000	S.F.	$ 4.50	$27,000
226	Concrete Masonry	1,690	C.Y.	37.00	62,530
227	Reinforcing Steel	94,000	Lbs.	0.11	5,940
228	Fan Chambers & Equipment	4	Ea.	17,500.00	70,000
					$165,470

V. RELOCATION OF CITY OWNED UTILITIES

A. WATER MAINS

1. St. James St. to Valentine St.

229	4" Main	640	L.F.	$ 2.50	$ 1,600
230	6" "	60	L.F.	3.00	180
231	8" "	42	L.F.	3.50	147
232	12" "	2,785	L.F.	3.00	11,835

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
233	16" Main	42	L.F.	6.00	252
					$16,104
	2. Valentine St. to Marcella St.				
234	6" Main	45	L.F.	$ 3.00	$ 135
	3. Marcella St. to Incline				
235	12" Main	70	L.F.	$ 5.00	$ 350
	B. SEWERS				
	1. St. James St. to Valentine St.				
236	12" Pipe	1,970	L.F.	$ 8.50	$16,745
237	15" "	770	L.F.	9.50	7,315
238	18" "	770	L.F.	11.00	8,470
239	24" "	60	L.F.	13.00	780
240	Sewer Manholes	10	Ea.	200.00	2,000
241	" "	3	Ea.	300.00	900
					$36,210
	2. Valentine St. to Marcella St.				
242	12" Pipe	80	L.F.	$ 8.50	$ 680
	C. SIPHONS				
	1. Valentine St. to Marcella St.				
243	At Thornton St. - 24" x 18"	80	L.F.	$ 53.00	$ 4,240
	VI. EQUIPMENT				
	A. PUMPS				
244	1. Dudley St.	1	Ea.	$2,000.00	$ 2,000
245	2. Marcella St.	1	Ea.	$2,000.00	$ 2,000
	B. STATION EQUIPMENT				
246	1. Dudley St.			L.S.	$22,000

No.	Item	Quantity	Unit	Unit Price	Amount
	16" Main	42	L.F.	6.00	252

2. Valentine St. to Marcella St.

	6" Main	45	L.F.	$ 3.00	$ 135

3. Marcella St. to Incline

	12" Main	70	L.F.	$ 5.00	$ 350

B. SEWERS

1. St. James St. to Valentine St.

	12" Pipe	1,970	L.F.	$ 8.50	$16,745
	15" "	770	L.F.	9.50	7,315
	18" "	770	L.F.	11.00	8,470
	24" "	60	L.F.	13.00	780
	Sewer Manholes	10	Ea.	200.00	2,000
	" "	3	Ea.	300.00	900
					$36,210

2. Valentine St. to Marcella St.

	12" Pipe	80	L.F.	$ 8.50	$ 680

C. SIPHONS

1. Valentine St. to Marcella St.

	[illegible] x 18"	80	L.F.	$ 53.00	$ 4,240

VI. EQUIPMENT

A. PUMPS

	1. Dudley St.	1	Ea.	$2,000.00	$ 2,000
	2. Marcella St.	1	Ea.	$1,000.00	$ 1,000

B. STATION EQUIPMENT

	1. Dudley St.			L.S.	$25,000

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	VII. CONSTRUCTION - LENOX ST. TO ST. JAMES ST.				
	A. LEGISLATIVE ROUTE				
	1. Rapid Transit Construction				
	a. Subway				
247	Excavation - 0' to 10'	41,990	C. Y.	$ 8.75	$367,413
248	" - over 10'	81,040	C. Y.	10.75	871,180
249	" - Conglomerate	7,020	C. Y.	12.00	84,240
250	Concrete Masonry	32,770	C. Y.	37.00	1,212,490
251	Reinforcing Steel	3,932,000	Lbs.	0.11	432,520
252	Structural Steel (Rolled)	2,963	Ton	275.00	814,825
253	Beam Wrapping	10,200	Lbs.	0.65	6,630
254	Decking - Roadway	4,755	S. Y.	30.00	142,650
255	" - Sidewalk	790	S. Y.	20.00	15,800
256	Restoration - Roadway	4,755	S. Y.	8.00	38,040
257	" - Sidewalk	790	S. Y.	9.00	7,110
258	Waterproofing - 6 Ply	19,940	S. Y.	5.20	103,688
259	" - 4 "	12,540	S. Y.	3.50	43,890
260	" - 3 "	7,320	S. Y.	2.70	19,764
					$4,160,240
	b. Dudley St. Station				
261	Excavation - 0' to 10'	11,840	C. Y.	$ 8.75	$103,600
262	" - over 10'	7,550	C. Y.	10.75	81,163
263	" - Conglomerate	20,000	C. Y.	12.00	240,000
264	Concrete Masonry	7,420	C. Y.	37.00	274,540
265	Reinforcing Steel	83,000	Lbs.	0.11	9,130
266	Structural Steel (Rolled)	1,267	Ton	275.00	348,425
267	Beam Wrapping	1,800	Lbs.	0.65	1,170
268	Decking - Roadway	380	S. Y.	30.00	11,400
269	" - Sidewalk	200	S. Y.	20.00	4,000
270	Restoration - Roadway	380	S. Y.	8.00	3,040
271	" - Sidewalk	200	S. Y.	9.00	1,800
272	Waterproofing - 6 Ply	3,950	S. Y.	5.20	20,540
273	" - 4 "	6,130	S. Y.	3.50	21,455
274	Concrete Finish	55,100	S. F.	0.30	16,530
275	Tile	17,000	S. F.	2.80	47,600
276	Railing	500	L. F.	6.00	3,000
277	Escalators			L. S.	282,000
					$1,469,393

a. Subway

247	Excavation - 0' to 10'	41,990	C. Y.	$ 8.75	$367,413
248	" - over 10'	81,040	C. Y.	10.75	871,180
249	" - Conglomerate	7,020	C. Y.	12.00	84,240
250	Concrete Masonry	32,770	C. Y.	37.00	1,212,490
251	Reinforcing Steel	1,912,000	Lbs.	0.11	421,320
252	Structural Steel (Rolled)	2,963	Ton	275.00	814,825
253	Beam Wrapping	10,200	Lbs.	0.65	6,630
254	Decking - Roadway	4,755	S. Y.	30.00	142,650
255	" - Sidewalk	790	S. Y.	20.00	15,800
256	Restoration - Roadway	4,755	S. Y.	8.00	38,040
257	" - Sidewalk	790	S. Y.	9.00	7,110
258	Waterproofing - 6 Ply	19,940	S. Y.	5.20	103,688
259	" - 4 "	12,540	S. Y.	3.50	43,890
260	" - 3 "	7,320	S. Y.	2.70	19,764
					$4,160,240

b. Dudley St. Station

261	Excavation - 0' to 10'	11,910	C. Y.	$ 11.75	$139,943
262	" - over 10'	7,550	C. Y.	10.75	81,163
263	" - Conglomerate	20,000	C. Y.	12.00	240,000
264	Concrete Masonry	1,440	C. Y.	148.00	213,120
265	Reinforcing Steel	83,000	Lbs.	0.11	9,130
266	Structural Steel (Rolled)	1,297	Ton	275.00	356,675
267	Beam Wrapping	1,800	Lbs.	0.65	1,170
268	Decking - Roadway	380	S. Y.	30.00	11,400
269	" - Sidewalk	200	S. Y.	20.00	4,000
270	Restoration - Roadway	380	S. Y.	8.00	3,040
271	" - Sidewalk	200	S. Y.	9.00	1,800
272	Waterproofing - 6 Ply	1,250	S. Y.	5.20	26,540
273	" - 4 "	6,130	S. Y.	3.50	21,455
274	Concrete Facing	551,100	S. F.	0.36	198,396
275	Tile	17,000	S. F.	0.28	47,600
276	Railing	500	L. F.	6.00	3,000
277	Excavation				
					$1,469,393

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	2. Underpinning				
	a. Lenox St. to St. James St. (Buildings)				
278	Concrete Masonry	1,720	C. Y.	$ 37.00	$63,640
279	Structural Steel (Temp)	500	Ton	180.00	90,000
280	" " (Rolled)	90	Ton	275.00	24,750
281	Demolition of Concrete	730	C. Y.	55.00	40,150
282	Timber	459	M. B. M.	200.00	91,800
283	Maintenance of Buildings			L. S.	35,000
					$345,340
	b. Williams St. to St. James St. (Elevated Columns)				
284	Excavation	1,460	C. Y.	$ 8.75	$12,775
285	Concrete Masonry	180	C. Y.	37.00	6,660
286	Reinforcing Steel	6,000	Lbs.	0.11	660
287	Structural Steel (Temp)	417	Ton	180.00	75,060
288	Demolition of Concrete	590	C. Y.	55.00	32,450
289	Timber	102	M. B. M.	200.00	20,400
290	Pipe Piles	2,450	L. F.	15.00	36,750
					$184,755
	c. Dudley St. Station (Bus Loop Columns)				
291	Concrete Masonry	700	C. Y.	$ 37.00	$25,900
292	Reinforcing Steel	22,100	Lbs.	0.11	2,431
293	Structural Steel (Temp)	98	Ton	180.00	17,640
294	Demolition of Concrete	510	C. Y.	55.00	28,050
295	Timber	78	M. B. M.	200.00	15,600
					$89,621
	3. Relocation of City Owned Utilities				
	a. Water Mains				
296	4" Main	78	L. F.	$ 2.50	$ 195
297	6" "	266	L. F.	3.00	798
298	8" "	182	L. F.	3.50	637
299	10" "	42	L. F.	4.00	168
300	12" "	1,204	L. F.	5.00	6,020
301	24" "	100	L. F.	10.00	1,000
					$ 8,818

c. Dudley St. Station (Bus Loop Columns)

Concrete Masonry	180	C. Y.	$ 37.00	
Reinforcing Steel	22,100	Lbs.	0.11	2,431
Structural Steel (Temp)	98	Ton	180.00	
Demolition of Concrete	510	C. Y.	55.00	28,050
Timber	78	M. B. M.	200.00	15,600

3. Relocation of City Sewer Section

a. Water Mains

4" Main	78	L. F.	$ 2.50	
6" "	266	L. F.	3.00	
8" "	182	L. F.	3.50	
10" "	42	L. F.	4.00	
12" "	1,204	L. F.	5.00	
24" "	100	L. F.	10.00	

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
	b. Sewers				
302	8" Pipe	50	L.F.	$ 7.00	$ 350
303	10" "	50	L.F.	8.00	400
304	12" "	370	L.F.	8.50	3,145
305	18" "	550	L.F.	11.00	6,050
306	30" "	40	L.F.	15.00	600
307	54" "	1,430	L.F.	21.00	30,030
308	Supports for 18" x 12" Brick	100	L.F.	10.00	1,000
309	Sewer Manholes	7	Ea.	200.00	1,400
310	" "	8	Ea.	300.00	2,400
					$45,375
	c. Siphons				
311	At Washington St. & Eustis St. - 10"	80	L.F.	$ 32.00	$ 2,560
	d. M.T.A. High Tension Duct				
312	Duct	222	L.F.	$ 2.20	$ 488
313	Manhole	1	Ea.	200.00	200
					$ 688
	4. Maintenance of Traffic				
314	a. Flagmen at Dudley St.	2	Yrs.	$12,000.00	$24,000
	B. ALTERNATE ROUTE				
	1. Demolition of Buildings at Dudley St. Station				
315	Boys Club of Boston	428,220	C.F.	$ 0.05	$21,411
316	U. S. Post Office	485,940	C.F.	0.05	24,297
317	54 Roxbury St.	55,320	C.F.	0.05	2,766
318	56-58 Roxbury St.	55,240	C.F.	0.05	2,762
319	72 " "	34,080	C.F.	0.05	1,704
320	74 " "	76,200	C.F.	0.05	3,810
321	78-82 " "	74,820	C.F.	0.05	3,741
					$60,491
	2. Rapid Transit Construction				
	a. Subway				
322	Excavation - 0' to 10'	55,180	C.Y.	$ 8.75	$482,825

No.	Item	Quantity	Unit	Unit Price	Amount
	b. Sewers				
302	8" Pipe	50	L. F.	$ 7.00	$ 350
303	10" "	50	L. F.	8.00	400
304	12" "	370	L. F.	8.50	3,145
305	18" "	550	L. F.	11.00	6,050
306	30" "	40	L. F.	15.00	600
307	54" "	1,430	L. F.	21.00	30,030
308	Supports for 18" x 12" Brick	100	L. F.	10.00	1,000
309	Sewer Manholes	7	Ea.	200.00	1,400
310	" "	8	Ea.	300.00	2,400
					$45,375
	c. Siphons				
311	At Washington St. & Eustis St. - 10"	80	L. F.	$ 32.00	$ 2,560
	d. M. T. A. High Tension Duct				
312	Duct	222	L. F.	$ 2.20	$ 488
313	Manhole	1	Ea.	200.00	200
					$ 688
	4. Maintenance of Traffic				
314	a. Flagmen at Dudley St.	2	Yrs.	$12,000.00	$24,000
	B. ALTERNATE ROUTE				
	1. Demolition of Buildings at Dudley St. Station				
315	Boys Club of Boston	428,220	C. F.	$ 0.05	$21,411
316	U. S. Post Office	485,940	C. F.	0.05	24,297
317	54 Roxbury St.	55,320	C. F.	0.05	2,766
318	56-58 Roxbury St.	55,240	C. F.	0.05	2,762
319	72 " "	34,080	C. F.	0.05	1,704
320	74 " "	76,200	C. F.	0.05	3,810
321	78-82 " "	74,820	C. F.	0.05	3,741
					$60,491
	2. Rapid Transit Construction				
	a. Subway				
322	Excavation - 0' to 10'	55,180	C. Y.	$ 8.75	$482,825

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
323	Excavation - over 10'	47,140	C.Y.	10.75	506,755
324	" - Conglomerate	5,380	C.Y.	12.00	64,560
325	Concrete Masonry	22,340	C.Y.	37.00	826,580
326	Reinforcing Steel	3,265,000	Lbs.	0.11	359,150
327	Decking - Roadway	13,700	S.Y.	30.00	411,000
328	" - Sidewalk	270	S.Y.	20.00	5,400
329	Restoration - Roadway	13,700	S.Y.	8.00	109,600
330	" - Sidewalk	270	S.Y.	9.00	2,430
331	Waterproofing - 6 Ply	11,160	S.Y.	5.20	58,032
332	" - 4 "	12,870	S.Y.	3.50	45,045
333	" - 3 "	11,160	S.Y.	2.70	30,132
					$2,901,509

b. Dudley St. Station

334	Excavation - 0' to 10'	14,620	C.Y.	$ 8.75	$127,925
335	" - over 10'	26,230	C.Y.	10.75	281,973
336	" - Conglomerate	9,000	C.Y.	12.00	108,000
337	Concrete Masonry	11,190	C.Y.	37.00	414,030
338	Reinforcing Steel	94,370	Lbs.	0.11	10,381
339	Structural Steel (Rolled)	1,463	Ton	275.00	402,325
340	Beam Wrapping	21,060	Lbs.	0.65	13,689
341	Waterproofing - 6 Ply	3,350	S.Y.	5.20	17,420
342	" - 4 "	11,650	S.Y.	3.50	40,775
343	Concrete Finish	100,830	S.F.	0.30	30,114
344	Tile	26,640	S.F.	2.80	74,592
345	Roofing	94,600	S.F.	1.30	122,980
346	Railing	2,090	L.F.	6.00	12,540
347	Chain Link Fence	700	L.F.	3.50	2,450
					$1,659,194

3. Underpinning

a. Lenox St. to St. James St. (Buildings)

348	Concrete Masonry	90	C.Y.	$ 37.00	$ 3,330
349	Structural Steel (Temp)	24	Ton	180.00	4,320
350	" " (Rolled)	4	Ton	275.00	1,100
351	Demolition of Concrete	40	C.Y.	55.00	2,200
352	Timber	22	M.B.M.	200.00	4,400
353	Maintenance of Buildings			L.S.	2,000
					$17,350

b. Bartlett St. to St. James St. (Elevated Columns)

354	Excavation	400	C.Y.	$ 8.75	$ 3,500

No.	Item	Quantity	Unit	Unit Price	Amount
323	Excavation - over 10'	47,140	C.Y.		506,755
324	" - Conglomerate	5,380	C.Y.	12.00	64,560
325	Concrete Masonry	22,340	C.Y.	37.00	826,580
326	Reinforcing Steel	3,265,000	Lbs.	0.11	359,150
327	Decking - Roadway	13,700	S.Y.	30.00	411,000
328	" - Sidewalk	270	S.Y.	20.00	5,400
329	Restoration - Roadway	13,700	S.Y.	8.00	109,600
330	" - Sidewalk	270	S.Y.	9.00	2,430
331	Waterproofing - 6 Ply	11,160	S.Y.	5.20	58,032
332	" - 4 "	12,870	S.Y.	3.50	45,045
333	" - 3 "	11,160	S.Y.	2.70	30,132
					$2,901,509

b. Dowling St. Station

334	Excavation - 0' to 10'	14,620	C.Y.	8.75	$127,925
335	" - over 10'	26,230	C.Y.	10.75	281,972
336	" - Conglomerate	9,000	C.Y.	12.00	108,000
337	Concrete Masonry	11,190	C.Y.	37.00	414,030
338	Reinforcing Steel	94,370	Lbs.	0.11	10,381
339	Structural Steel (Painted)	1,449	Tons	275.00	402,325
340	Beam Wrapping	21,060	L.F.	0.65	13,689
341	Waterproofing - 6 Ply	3,350	S.Y.	5.20	17,420
342	" - 4 "	11,650	S.Y.	3.50	40,775
343	Concrete Piles	100,814	L.F.	0.30	30,114
344	Tile	26,640	S.F.	2.80	74,592
345	Roofing	94,600	S.F.	1.30	122,980
346	Railing	2,090	L.F.	6.00	12,540
347	Chain Link Fence	700	L.F.	3.50	2,450
					$1,659,194

c. Dowling

c. Lanes EB to St. James St. (Buildings)

348	Concrete Masonry		C.Y.	$ 37.00	$ 3,330
349	Structural Steel (Temp)	24	Tons		
350	" " (Rolled)	4	Tons	275.00	1,100
351	Demolition of Concrete	40	C.Y.	55.00	2,200
352	Timber	22	M.F.B.M.	200.00	4,400
353	Maintenance of Buildings				2,000
					$17,350

b. Dowling EB to St. James St. (Elevated Columns)

354	Excavation	456	C.Y.	$ 8.75	$ 3,990

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

No.	Item	Quantity	Unit	Unit Price	Amount
355	Concrete Masonry	32	C. Y.	37.00	1,184
356	Structural Steel (Temp)	136	Ton	180.00	24,480
357	Demolition of Concrete	200	C. Y.	55.00	11,000
358	Timber	32	M. B. M.	200.00	6,400
359	Pipe Piles	800	L. F.	15.00	12,000
					$58,564

4. Relocation of City Owned Utilities

a. Water Mains

360	6" Main	155	L. F.	$ 3.00	$ 465
361	8" "	80	L. F.	3.50	280
362	10" "	77	L. F.	4.00	308
363	12" "	670	L. F.	5.00	3,350
364	16" "	2,009	L. F.	6.00	12,054
365	24" "	70	L. F.	10.00	700
366	Water Manholes	14	Ea.	200.00	2,800
					$19,957

b. Sewers

367	10" Pipe	495	L. F.	$ 8.00	$ 3,960
368	12" "	970	L. F.	8.50	8,245
369	15" "	1,160	L. F.	9.50	11,020
370	18" "	2,815	L. F.	11.00	30,965
371	21" "	635	L. F.	12.00	7,620
372	24" "	190	L. F.	13.00	2,470
373	30" "	180	L. F.	15.00	2,700
374	33" "	365	L. F.	16.00	5,840
375	36" "	440	L. F.	17.00	7,480
376	54" "	1,105	L. F.	21.00	23,205
377	78" "	510	L. F.	30.00	15,300
378	Sewer Manholes	13	Ea.	200.00	2,600
379	" "	44	Ea.	300.00	13,200
380	10' x 10' Overflow Chamber	1	Ea.	2,000.00	2,000
					$136,605

c. Siphons

381	At. Ruggles St. - 15"	80	L. F.	$ 40.00	$ 3,200
382	" " " - 18"	80	L. F.	44.00	3,520
					$ 6,720

d. M. T. A. High Tension Duct

383	Duct	140	L. F.	$ 2.20	$ 308

No.	Item	Quantity	Unit	Unit Price	Amount
135	Concrete Masonry	32	C. Y.	37.00	1,184
136	Structural Steel (Temp)	136	Lbs.	180.00	24,480
137	Demolition of Concrete	200	C. Y.	55.00	11,000
138	Timber	14	M. B. M.	200.00	6,400
139	Pipe Piles	800	L. F.	15.00	12,000
					$54,744

4. Relocation of City Owned Utilities

a. Water Mains

140	6" Main	155	L. F.	$ 3.00	$ 465
141	8" "	80	L. F.	3.50	280
142	10" "	77	L. F.	4.00	308
143	12" "	670	L. F.	5.00	3,350
144	14" "	1,889	L. F.	6.00	11,334
145	24" "	70	L. F.	10.00	700
146	Water Manholes	14	Ea.	200.00	2,800
					$19,937

b. Sewers

147	10" Pipe	495	L. F.	$ 8.00	$ 3,960
148	12" "	975	L. F.	8.50	8,288
149	15" "	1,160	L. F.	9.50	11,020
150	18" "	2,815	L. F.	11.00	30,965
151	21" "	635	L. F.	12.00	7,620
152	24" "	190	L. F.	13.00	2,470
153	30" "	180	L. F.	15.00	2,700
154	36" "	345	L. F.	16.00	5,520
155	54" "	440	L. F.	17.00	7,480
156	78" "	1,105	L. F.	21.00	23,205
157	78" "	510	L. F.	30.00	15,300
158	Sewer Manholes	13	Ea.	200.00	2,600
159	" "	69	Ea.	300.00	13,200
160	10' x 10' Overflow Chamber	1	Ea.	2,000.00	2,000
					$176,853

c. Storm Drains

161	As Required - 18"	40	L. F.	$ 40.00	$ 1,200
162	" " " - 15"	80	L. F.	44.00	3,520
					$ 4,720

d. M. T. A. Utility Tunnel Duct

163	Duct	148	L. F.	$ 2.50	$ 370

LENOX ST. TO END OF INCLINE AT RITCHIE ST.

I. Including Legislative Route from Lenox St. to St. James St.

Summary Item Nos.	185-246	$4,536,270
Summary Item Nos.	247-314	6,330,790
Construction Cost		10,867,060
Contingencies - 10%		1,086,706
		11,953,766
Engineering & Administration - 10%		1,195,377
		$13,149,143*

II. Including Alternate Route from Lenox St. to St. James St.

Summary Item Nos.	185-246	$4,536,270
Summary Item Nos.	315-383	4,860,698
Construction Cost		9,396,968
Contingencies - 10%		939,697
		10,336,665
Engineering & Administration - 10%		1,033,667
		$11,370,332*

* Does not include cost of : Track Work, Power, Signals and Lighting, Land Damages, Demolition of Existing Washington St. Elevated and Interest During Construction

ESTIMATE

END OF INCLINE AT RITCHIE ST. TO FOREST HILLS

No.	Item	Quantity	Unit	Unit Price	Amount
	I. PRELIMINARY WORK				
384	Borings and Test Pits			L. S.	$15,750
	II. DEMOLITION OF BUILDINGS				
	A. COLUMBUS AVE. BUS TERMINAL				
385	1575-77 Columbus Ave.	100,000	C. F.	$ 0.05	$ 5,000
386	1579-85 Columbus Ave.	8,400	C. F.	0.05	420
387	32-36 Amory St.	9,920	C. F.	0.05	496
388	40-46 Amory St.	18,600	C. F.	0.05	930
389	1589 Columbus Ave.	81,000	C. F.	0.05	4,050
390	48 Amory St.	121,500	C. F.	0.05	6,075
391	1589A Columbus Ave.	27,000	C. F.	0.05	1,350
392	60 Amory St.	22,500	C. F.	0.05	1,125
393	1641 Columbus Ave.	18,300	C. F.	0.05	915
394	1647 Columbus Ave.	24,000	C. F.	0.05	1,200
395	64 Amory St.	15,000	C. F.	0.05	750
396	30 Amory St.	4,800	C. F.	0.05	240
					$22,551
	B. RELOCATION OF AMORY ST.				
397	31-33 Amory St.	91,800	C. F.	$ 0.05	$ 4,590
398	29 Amory St.	52,500	C. F.	0.05	2,625
					$ 7,215
	C. EMBANKMENT (STA 161 + 61 TO WILLIAMS ST.)				
399	146 Amory St.	138,600	C. F.	$ 0.03	$ 4,158
400	Barney & Cary Lumber Co.	83,880	C. F.	0.03	2,516
401	Farrington Manufacturing Co.	43,000	C. F.	0.03	1,290
					$ 7,964
	D. GREEN ST. BUS TERMINAL				
402	Paint Factory	75,000	C. F.	$ 0.05	$ 3,750
403	Soap Factory	20,400	C. F.	0.05	1,020
					$ 4,770

No.	Item	Quantity	Unit	Unit Price	Amount
384	Borings and Test Pits		L. S.		$15,750

II. DEMOLITION OF BUILDINGS

A. COLUMBUS AVE. BUS TERMINAL

385	1575-77 Columbus Ave.	100,000	C. F.	$ 0.05	$ 5,000
386	1579-85 Columbus Ave.	8,400	C. F.	0.05	420
387	32-36 Amory St.	9,920	C. F.	0.05	496
388	40-46 Amory St.	18,600	C. F.	0.05	930
389	1588 Columbus Ave.	85,000	C. F.	0.05	4,250
390	48 Amory St.	121,500	C. F.	0.05	6,075
391	1589A Columbus Ave.	27,000	C. F.	0.05	1,350
392	60 Amory St.	22,500	C. F.	0.05	1,125
393	1641 Columbus Ave.	18,300	C. F.	0.05	915
394	1647 Columbus Ave.	24,000	C. F.	0.05	1,200
395	64 Amory St.	15,000	C. F.	0.05	750
396	30 Amory St.	4,800	C. F.	0.05	240

B. RELOCATION OF AMORY ST.

397	31-33 Amory St.	91,800	C. F.	$ 0.05	$ 4,590
398	29 Amory St.	52,500	C. F.	0.05	2,625

C. REARRANGEMENT [ETA 181 & AT TO WILLIAMS ST.]

399	146 Amory St.	138,600	C. F.	$ 0.03	$ 4,158
400	Savory & Carey Electric Co.	83,880	C. F.	0.03	2,516
401	Farrington Manufacturing Co.	43,000	C. F.	0.03	1,290

D. [illegible] ST., BUS TERMINAL

402	Plaza Bakery	75,000	C. F.	$ 0.05	$ 3,750
403	Soap Factory	99,400	C. F.	0.04	3,976

END OF INCLINE AT RITCHIE ST. TO FOREST HILLS

No.	Item	Quantity	Unit	Unit Price	Amount
	III. RAPID TRANSIT CONSTRUCTION				
	A. COLUMBUS AVE. STATION				
404	Excavation	600	C. Y.	$ 8.75	$ 5,250
405	Concrete Masonry	3,190	C. Y.	37.00	118,030
406	Reinforcing Steel	65,300	Lbs.	0.11	7,183
407	Structural Steel (Rolled)	361	Ton	275.00	99,275
408	" " (Built Up)	416	Ton	425.00	176,800
409	Beam Wrapping	20,330	Lbs.	0.65	13,215
410	Concrete Finish	18,000	S. F.	0.30	5,400
411	Glass Brick (6" x 6")	8,384	Ea.	1.60	13,414
412	Roofing & Siding	28,360	S. F.	1.30	36,868
413	Railing	900	L. F.	6.00	5,400
414	Chain Link Fence	2,150	L. F.	3.50	7,525
					$488,360
	B. ELEVATED SECTION SOUTH OF COLUMBUS AVE. STATION				
415	Excavation	190	C. Y.	$ 8.75	$ 1,663
416	Concrete Masonry	90	C. Y.	37.00	3,330
417	Reinforcing Steel	5,130	Lbs.	0.11	564
418	Structural Steel (Rolled)	21	Ton	275.00	5,775
419	" " (Built-Up)	161	Ton	425.00	68,425
420	Service Walk - Timber	14	M. B. M.	200.00	2,800
					$82,557
	C. EMBANKMENT SECTION PARALLEL TO N. Y., N. H. & H. R. R. TRACKS				
	1. Abutment Sta. 161 + 61				
421	Concrete Masonry	100	C. Y.	$ 37.00	$ 3,700
422	Reinforcing Steel	23,900	Lbs.	0.11	2,629
					$ 6,329
	2. Atherton St. Bridge				
423	Excavation	1,320	C. Y.	$ 2.00	$ 2,640
424	Concrete Masonry	500	C. Y.	37.00	18,500
425	Reinforcing Steel	93,550	Lbs.	0.11	10,290
426	Structural Steel (Rolled)	11	Ton	275.00	3,025
427	" " (Built-Up)	20	Ton	425.00	8,500
					$42,955

No.	Item	Quantity	Unit	Unit Price	Amount
	III. MAIN TRAINS CONSTRUCTION				
	A. COLUMBUS AVE. STATION				
404	Excavation	600	C. Y.	$ 8.75	$ 5,250
405	Concrete Masonry	3,190	C. Y.	37.00	118,030
406	Reinforcing Steel	65,300	Lbs.	0.11	7,183
407	Structural Steel (Rolled)	361	Ton	275.00	99,275
408	" " (Built Up)	416	Ton	425.00	176,800
409	Beam Wrapping	20,330	Lbs.	0.65	13,215
410	Concrete Finish	18,000	S.F.	0.30	5,400
411	Glass Brick (6" x 6")	8,384	Ea.	1.60	13,414
412	Roofing & Siding	28,360	S.F.	1.30	36,868
413	Railing	900	L.F.	6.00	5,400
414	Chain Link Fence	2,150	L.F.	3.50	7,525
					586,760
	B. ELEVATED SECTION SOUTH OF COLUMBUS AVE. STATION				
415	Excavation	190	C. Y.	$ 8.75	$ 1,663
416	Concrete Masonry	90	C. Y.	37.00	3,330
417	Reinforcing Steel	9,149	Lbs.	0.11	1,006
418	Structural Steel (Rolled)	21	Ton	275.00	5,775
419	" " (Built-Up)	161	Ton	425.00	68,425
420	Service Walk - Timber	14	M. B. M.	200.00	2,800
					83,017
	C. EMBANKMENT SECTION PARALLEL TO N. Y., N. H. & H. R. R. TRACKS				
	1. Abutment No. 1A to 1				
421	Concrete Masonry	100	C. Y.	$ 37.00	$ 3,700
422	Reinforcing Steel	21,900	Lbs.	0.11	2,409
					6,109
	2. Abutment No. Three				
423	Excavation	1,200	C. Y.	$ 8.00	$ 9,600
424	Concrete Masonry	500	C. Y.	37.00	18,500
425	Reinforcing Steel	93,550	Lbs.	0.11	10,290
426	Structural Steel (Rolled)	11	Ton	275.00	3,025
427	" " (Built-Up)	20	Ton	425.00	8,500
					49,915

END OF INCLINE AT RITCHIE ST. TO FOREST HILLS

No.	Item	Quantity	Unit	Unit Price	Amount
	3. Pedestrian Underpass at Minton St.				
428	Concrete Masonry	56	C. Y.	$ 37.00	$ 2,072
429	Reinforcing Steel	10,000	Lbs.	0.11	1,100
					$ 3,172
	4. Boylston St. Bridge				
430	Excavation	900	C. Y.	$ 2.00	$ 1,800
431	Concrete Masonry	430	C. Y.	37.00	15,910
432	Reinforcing Steel	86,000	Lbs.	0.11	9,460
433	Structural Steel (Rolled)	12	Ton	2.75	3,300
434	" " (Built-up)	21	Ton	4.25	8,925
					$39,395
	5. Green St. Bridge				
435	Concrete Masonry	250	C. Y.	$ 37.00	$ 9,250
436	Reinforcing Steel	32,000	Lbs.	0.11	3,520
437	Structural Steel (Rolled)	16	Ton	275.00	4,400
438	" " (Built-up)	27	Ton	425.00	11,475
					$28,645
	6. Abutment at Williams St.				
439	Concrete Masonry	120	C. Y.	$ 37.00	$ 4,440
440	Reinforcing Steel	21,200	Lbs.	0.11	2,332
					$ 6,772
	7. Retaining Walls, etc.				
441	Excavation	12,700	C. Y.	$ 2.00	$25,400
442	Concrete Masonry	6,250	C. Y.	37.00	231,250
443	Reinforcing Steel	640,900	Lbs.	0.11	70,499
444	Fill	92,000	C. Y.	0.50	46,000
445	Sheeting	13,440	S. F.	3.00	40,320
446	Chain Link Fence	11,300	L. F.	3.50	39,550
447	Demolition of Concrete	450	C. Y.	55.00	24,750
448	Removal of Electric Poles	65	Ea.	10.00	650
449	Electrical Conduit	6,200	L. F.	2.20	13,640
450	Removal of Spur Track	1,800	L. F.	1.00	1,800
					$493,859

No.	Item	Quantity	Unit	Unit Price	Amount
	5. Pedestrian Underpass at Minton St.				
428	Concrete Masonry	54	C. Y.	$ 37.00	$ 1,998
429	Reinforcing Steel	4,840	Lbs.	0.14	678
					$ 2,676
	6. Division St. Bridge				
430	Excavation	900	C. Y.	$ 2.00	$ 1,800
431	Concrete Masonry	410	C. Y.	37.00	15,170
432	Reinforcing Steel	86,000	Lbs.	0.11	9,460
433	Structural Steel (Rolled)	12	Tons	2.75	33
434	" " (Built-up)	31	Tons	4.25	132
					$25,595
	7. Division St. Bridge				
435	Concrete Masonry	357	C. Y.	$ 37.00	$ 9,236
436	Reinforcing Steel	32,000	Lbs.	0.11	3,520
437	Structural Steel (Rolled)	16	Tons	275.00	4,400
438	" " (Built-up)	27	Tons	425.00	11,475
					$28,631
	8. Abutment at Williams St.				
439	Concrete Masonry	120	C. Y.	$ 37.00	$ 4,440
440	Reinforcing Steel	21,200	Lbs.	0.11	2,332
					$ 6,772
	9. Retaining Walls, etc.				
441	Excavation	12,700	C. Y.	$ 2.00	$25,400
442	Concrete Masonry	6,110	C. Y.	37.00	226,070
443	Reinforcing Steel	440,000	Lbs.	0.11	48,400
444	Piling	12,250	C. Y.	0.50	6,125
445	Sheeting	13,140	M. F.	3.00	39,420
446	Chain Link Fence	11,100	L. F.	3.50	38,850
447	Demolition of Concrete	450	C. Y.	55.00	24,750
448	Removal of Electric Poles	46	Ea.	10.00	460
449	Electrical Conduit	4,400	L. F.	2.20	9,680
450	Removal of Open Trench	1,900	L. F.	1.00	1,900
					$421,055

END OF INCLINE AT RITCHIE ST. TO FOREST HILLS

No.	Item	Quantity	Unit	Unit Price	Amount
	D. GREEN ST. STATION				
451	Excavation	1,200	C. Y.	$ 2.00	$ 2,400
452	Concrete Masonry	2,390	C. Y.	37.00	88,430
453	Reinforcing Steel	272,070	Lbs.	0.11	29,928
454	Structural Steel (Rolled)	109	Ton	275.00	29,975
455	" " (Built-up)	37	Ton	425.00	15,725
456	Beam Wrapping	9,480	Lbs.	0.65	6,162
457	Concrete Finish	14,850	S. F.	0.30	4,455
458	Glass Brick (8" x 8")	6,480	Ea.	3.00	19,440
459	Roofing & Siding	22,470	S. F.	1.30	29,211
460	Chain Link Fence	535	L. F.	3.50	1,872
461	Railing	420	L. F.	6.00	2,520
					$230,118
	E. ELEVATED SECTION - WILLIAMS ST. TO BROOKLEY RD.				
462	Excavation	670	C. Y.	$ 8.75	$ 5,863
463	Concrete Masonry	480	C. Y.	37.00	17,760
464	Reinforcing Steel	27,290	Lbs.	0.11	3,002
465	Structural Steel (Rolled)	56	Ton	275.00	15,400
466	" " (Built-up)	433	Ton	425.00	184,025
467	Service Walk - Timber	10	M. B. M.	200.00	2,000
					$228,050
	F. STONY BROOK CULVERT				
468	Culvert	2,500	L. F.	$250.00	$625,000
469	Temporary Diversion of Flow			L. S.	50,000
					$675,000
	G. BROOKLEY RD. CONNECTION				
470	Excavation	470	C. Y.	$ 8.75	$ 4,113
471	Concrete Masonry	170	C. Y.	37.00	6,290
472	Reinforcing Steel	10,000	Lbs.	0.11	1,100
473	Structural Steel (Rolled)	24	Ton	275.00	6,600
474	" " (Built-up)	64	Ton	425.00	27,200
475	" " (Temp.)	38	Ton	180.00	6,840
476	Demolition of Concrete	25	C. Y.	55.00	1,375
477	Timber	6	M. B. M.	200.00	1,200
					$54,718

D. GREEN ST. STATION

No.	Item	Quantity	Unit	Unit Price	Amount
451	Excavation	1,100	C. Y.	$ 2.00	$ 2,400
452	Concrete Masonry	2,140	C. Y.	37.00	88,430
453	Reinforcing Steel	272,070	Lbs.	0.11	29,928
454	Structural Steel (Rolled)	109	Ton	275.00	
455	" " (Built-up)	37	Ton	425.00	15,725
456	Beam Wrapping	9,480	Lbs.	0.65	6,162
457	Concrete Piles	14,850	S.F.	0.30	4,455
458	Glass Brick (8" x 8")	6,480	Ea.	3.00	
459	Roofing & Siding	22,470	S.F.	1.30	29,211
460	Chain Link Fence	243	L.F.	3.50	1,872
461	Railing	420	L.F.	6.00	2,520

E. ELEVATED SECTION - WILLIAMS ST. TO BROOKLEY RD.

462	Excavation	670	C. Y.	$ 8.75	
463	Concrete Masonry	480	C. Y.	37.00	
464	Reinforcing Steel	27,290	Lbs.	0.11	
465	Structural Steel (Rolled)	56	Ton	275.00	
466	" " (Built-up)	433	Ton	425.00	
467	Service Walk - Timber	10	M. B. M.	200.00	

F. STONY BROOK CULVERT

468	Culvert	2,500	L. F.	$6125,000
469	Temporary Diversion of Flow		L. S.	50,000
				$6175,000

G. BRUNDALEE RD. CONNECTION

470	Excavation	470	C. Y.	
471	Concrete Masonry	140	C. Y.	37.00
472	Reinforcing Steel	10,000	Lbs.	0.11
473	Structural Steel (Rolled)	24	Ton	275.00
474	" " (Built-up)	64	Ton	425.00
475	" " (Temp.)	38	Ton	180.00
476	Demolition of Concrete	25	C. Y.	55.00
477	Timber	6	M. B. M.	200.00

END OF INCLINE AT RITCHIE ST. TO FOREST HILLS

No.	Item	Quantity	Unit	Unit Price	Amount
	IV. RELOCATION OF CITY OWNED UTILITIES				
	A. SEWERS				
478	1. 2'-0" x 3'-6" Sewer of Stony Brook Culvert	2,500	L.F.	$ 32.40	$81,000
	V. EQUIPMENT				
	A. STATION EQUIPMENT				
479	1. Columbus Ave.			L.S.	$22,000
480	2. Green St.			L.S.	$22,000
	VI. MAINTENANCE OF TRAFFIC				
481	1. Flagmen at Brookley Rd.	2	Yrs.	$12,000.00	$24,000
	Construction Cost - Summary Item Nos. 384-481				$2,587,180
	Contingencies - 10%				258,718
					2,845,898
	Engineering & Administration - 10%				284,590
					$3,130,488*

* Does not include cost of: Track Work, Power, Signals and Lighting, Land Damages, Demolition of Existing Washington St. Elevated and Interest During Construction.

No.	Item	Quantity	Unit	Unit Price	Amount
	IV. RELOCATION OF CITY OWNED UTILITIES				
	A. SEWERS				
478	1. 2'-0" x 3'-6" Sewer of Stony Brook Convent	1,000	L. F.	$ 12.40	$12,400
	V. EQUIPMENT				
	A. STATION EQUIPMENT				
479	1. Columbus Ave.		L. S.		$22,000
480	2. Green St.		L. S.		$22,000
	VI. MAINTENANCE OF TRAFFIC				
481	1. Flagmen at Brooklyn Rd.		Lsm.	$15,000.00	$15,000
	Construction Cost -				
	Summary Item Nos. 384-481				$2,587,180
	Contingencies - 10%				258,718
					2,845,898
	Engineering & Administration - 10%				284,590
					$3,130,488*

* Does not include cost of: Track Work, Power, Signals and Lighting, Land Damages, Demolition of Existing Washington St. Elevated and Interest During Construction.

ESTIMATE

MISCELLANEOUS ITEMS

No.	Item	Quantity	Unit	Unit Price	Amount
	I. DEMOLITION OF EXISTING WASHINGTON ST. ELEVATED				
482	Removal of Structural Steel	11,100	Ton	$ 60.00	$666,000
483	Credit for Scrap	11,100	Ton	40.00	444,000
					$222,000
	II. LEGISLATIVE ROUTE				
484	1. Track Work			L.S.	$870,550
485	2. Power			L.S.	1,133,600
486	3. Signals & Lighting			L.S.	1,218,000
					$3,222,150
487	4. Land Damages			L.S.	$1,202,170
	III. ALTERNATE ROUTE				
488	1. Track Work			L.S.	$832,880
489	2. Power			L.S.	1,102,600
490	3. Signals & Lighting			L.S.	1,218,000
					$3,153,480
491	4. Land Damages			L.S.	$1,262,420

No.	Item	Quantity	Unit	Unit Price	Amount
	I. DEMOLITION OF EXISTING WARDROBE				
483	Credit for Scrap	11.100	Ton	40.00	
	II. LEGISLATIVE ROUTE				
	1. Track Work		L.S.		
	2. Power		L.S.		
	3. Signals & Lighting		L.S.		
	4. Land Damages				
	III. ALTERNATE ROUTE				
	1. Track Work		L.S		
	2. Power		L.S.		
490	3. Signals & Lighting		L.S		
491	4. Land Damages		L.S.		

SUMMARY

Nos.	Item	Amount	Total
	I. PRELIMINARY WORK		
1	Borings and Test Pits	$ 4,500	
116	" " " "	9,000	
185	" " " "	15,750	
384	" " " "	15,750	$ 45,000
	II. DEMOLITION OF BUILDINGS		
385-396	Columbus Ave. Bus Terminal	22,551	
397-398	Relocation of Amory St.	7,215	
399-401	Embankment Section	7,964	
402-403	Green St. Bus Terminal	4,770	42,500
	III. RAPID TRANSIT CONSTRUCTION		
2-11	Boylston St. Connection	254,425	
12-20	Dore St. to Oak St.	794,481	
21-33	Compton St. to Dover St.	558,796	
117-125	Dover St. to Lenox St.	3,744,288	
126-141	Union Park St. Station	1,114,011	
142-156	Massachusetts Ave. Station	1,097,133	
186-195	St. James St. to Kingsbury St.	1,821,039	
196-209	Kingsbury St. to Incline	1,985,725	
210-212	Incline at Ritchie St.	66,977	
404-414	Columbus Ave. Station	488,360	
415-420	Elevated Section South of Columbus Ave. Station	82,557	
421-450	Embankment Section Parallel to N. Y., N. H. & H. R. R. Tracks	621,127	
451-461	Green St. Station	230,118	
462-467	Elevated Section - Williams St. to Brookley Rd.	228,050	
468-469	Stony Brook Culvert	675,000	
470-477	Brookley Rd. Connection	54,718	13,816,805
	IV. UNDERPINNING		
34-39	Cobb St. to Dover St. (Buildings)	158,745	
213-218	Valentine St. to Marcella St. "	92,255	
219-224	St. James St. to Valentine St. (Elevated Columns)	305,335	556,335

SUMMARY

Sheet	Item	Amount	Total
	I. PRELIMINARY WORK		
1	Borings and Test Pits	$ 4,500	
[illegible]	" " " "	9,000	
[illegible]	" " " "	15,750	
[illegible]	" " " "	15,750	$ 45,000
	II. DEMOLITION OF BUILDINGS		
[illegible]	Columbus Ave. Bus Terminal	22,551	
[illegible]	Relocation of Amory St.	7,215	
[illegible]	Embankment Section	7,964	
[illegible]	Green St. Bus Terminal	4,770	42,500
	III. RAPID TRANSIT CONSTRUCTION		
2-11	Boylston St. Connection	254,425	
12-20	Dore St. to Oak St.	794,481	
21-33	Compton St. to Dover St.	558,796	
117-125	Dover St. to Lenox St.	3,744,288	
126-141	Union Park St. Station	1,114,011	
142-156	Massachusetts Ave. Station	1,097,133	
186-195	St. James St. to Kingsbury St.	1,821,039	
196-209	Kingsbury St. to Incline	1,985,725	
210-212	Incline at Ritchie St.	66,977	
404-414	Columbus Ave. Station	488,360	
415-420	Elevated Section South of Columbus Ave. Station	82,557	
421-450	Embankment Section Parallel to N.Y., N.H. & H. R. R. Tracks	621,127	
451-461	Green St. Station	230,118	
462-467	Elevated Section - Williams St. to Brookley Rd.	228,050	
468-469	Stony Brook Culvert	675,000	
470-477	Brookley Rd. Connection	54,718	13,816,805
	IV. UNDERPINNING		
[illegible]	Cobb St. to Dover St. (Buildings)	[illegible]	
213-218	Valentine St. to Marcella St. "	92,255	
219-224	St. James St. to Valentine St. (Elevated Columns)	305,335	[illegible]

SUMMARY

Nos.	Item	Amount	Total
	V. VENTILATION		
40-43	Existing Boylston Station to Dover St.	58,720	
157-160	Dover St. to Lenox St.	121,210	
225-228	Lenox St. to Incline at Ritchie St.	165,470	345,400
	VI. RELOCATION OF CITY OWNED UTILITIES		
	A. WATER MAINS		
44-46	Boylston St. to Warrenton St.	12,284	
47-52	Warrenton St. to Dover St.	4,632	
161-167	Dover St. to Lenox St.	36,428	
229-233	St. James St. to Valentine St.	16,104	
234	Valentine St. to Marcella St.	135	
235	Marcella St. to Incline	350	69,933
	B. SEWERS		
53-57	Boylston St. to Warrenton St.	18,920	
58-63	Warrenton St. to Dover St.	5,000	
168-176	Dover St. to Lenox St.	100,800	
236-241	St. James St. to Valentine St.	36,210	
242	Valentine St. to Marcella St.	680	
478	2'-0" x 3'-6" Sewer of Stony Brook Culvert	81,000	242,610
	C. SIPHONS		
64	Boylston St. to Warrenton St.	4,880	
177-178	Dover St. to Lenox St.	26,400	
243	Valentine St. to Marcella St.	4,240	35,520
	D. FIRE MAINS		
65	Boylston St. to Warrenton St.	17,413	17,413
	E. M.T.A. HIGH TENSION DUCT		
66	Warrenton St. to Dover St.	924	
179-180	Dover St. to Lenox St.	3,200	4,124

Nos.	Item	Amount	Total
	V. VENTILATION		
40-43	Existing Boylston Station to Dover St.	58,720	
197-199	Dover St. to Lenox St.	121,215	
225-228	Lenox St. to Incline at Ritchie St.	165,470	345,400
	VI. RELOCATION OF UTILITY OWNERS' UTILITIES		
	A. WATER MAINS		
44-46	Boylston St. to Warrenton St.	12,284	
47-52	Warrenton St. to Dover St.	4,632	
161-167	Dover St. to Lenox St.	36,428	
229-233	St. James St. to Valentine St.	16,104	
234	Valentine St. to Marcella St.	135	
235	Marcella St. to Incline	350	69,933
	B. SEWERS		
33-37	Boylston St. to Warrenton St.	18,920	
44-45	Warrenton St. to Dover St.	5,000	
166-171	Dover St. to Lenox St.	100,800	
215-221	St. James St. to Valentine St.	36,210	
233	Valentine St. to Marcella St.	680	
234	2'-0" x 3'-6" Sewer of Stony Brook Culvert	81,000	242,610
	C. CONDUITS		
44	Boylston St. to Warrenton St.	4,800	
171-173	Dover St. to Lenox St.	26,160	
241	Valentine St. to Marcella St.	4,240	35,520
	D. GAS MAINS		
44	Boylston St. to Warrenton St.	17,413	17,413
	E. MULTI-DUCT TELEPHONE DUCTS		
46	Warrenton St. to Dover St.	924	
179-182	Dover St. to Lenox St.	3,200	4,124

SUMMARY

Nos.	Item	Amount	Total
	VII. EQUIPMENT		
	A. PUMPS		
67	Corning St.	10,000	
181	Union Park St.	2,000	
182	Massachusetts Ave.	2,000	
244	Dudley St.	2,000	
245	Marcella St.	2,000	18,000
	B. STATION EQUIPMENT		
183	Union Park St.	22,000	
184	Massachusetts Ave.	22,000	
246	Dudley St.	22,000	
479	Columbus Ave.	22,000	
480	Green St.	22,000	110,000
	VIII. MAINTENANCE OF TRAFFIC		
68	Flagmen at Boylston St.	24,000	
481	" " Brookley Rd.	24,000	48,000
482-483	**IX. DEMOLITION OF EXISTING WASHINGTON ST. ELEVATED**		222,000
	Summary Item Nos. 1-68, 116-246, 384, 483		$15,573,640
	X. CONSTRUCTION - OAK ST. TO COMPTON ST.		
	A. OPEN CUT METHOD UNDER N. Y., N. H. & H. & B. & A. R. R. TRACKS		
69-81	Rapid Transit Construction	$1,690,800	
82-87	Underpinning Buildings	99,545	
88-91	" N. Y., N. H. & H. & B. & A. R. R. Tracks	141,350	
92-94	Underpinning Retaining Walls	31,623	$1,963,318
	B. SHIELD DRIVEN TUNNEL ALTERNATE UNDER N. Y., N. H. & H. & B. & A. R. R. TRACKS		
95-106	Tunnel	2,038,081	
107-115	Transition Subway Section	681,554	$2,719,635

67	Corning St.	10,000	
181	Union Park St.	2,000	
182	Massachusetts Ave.	2,000	
245	Marcella St.	2,000	18,000
184	Union Park St.	22,000	
184	Massachusetts Ave.	22,000	
479	Dudley St.	22,000	
480	Columbus Ave.	22,000	
	Green St.	22,000	110,000
68	Flagmen at Boylston St.	24,000	
481	" " Brookley Rd.	24,000	48,000
			222,000
69-81	Rapid Transit Construction	$1,690,800	
82-87	Underpinning Buildings	99,545	
88-91	" N. Y., N. H. & H. R. R. Tracks	141,350	
92-94	Underpinning Retaining Walls	31,623	$1,963,318
95-106	Tunnel	2,038,081	

SUMMARY

Nos.	Item	Amount	Total
	XI. CONSTRUCTION - LENOX ST. TO ST. JAMES ST.		
	A. LEGISLATIVE ROUTE		
247-260	Rapid Transit Construction - Subway	4,160,240	
261-277	Rapid Transit Construction - Dudley St. Station	1,469,393	
278-283	Underpinning - Buildings	345,340	
284-290	" - Elevated Columns	184,755	
291-295	" - Dudley St. Station (Bus Loop Columns)	89,621	
296-301	Relocation of City Owned Utilities - Water Mains	8,818	
302-310	Relocation of City Owned Utilities - Sewers	45,375	
311	Relocation of City Owned Utilities - Siphons	2,560	
312-313	Relocation of City Owned Utilities - M.T.A. High Tension Duct	688	
314	Maintenance of Traffic	24,000	6,330,790
	B. ALTERNATE ROUTE		
315-321	Demolition of Buildings at Dudley St. Station	$ 60,491	
322-333	Rapid Transit Construction - Subway	2,901,509	
334-347	Rapid Transit Construction - Dudley St. Station	1,659,194	
348-353	Underpinning - Buildings	17,350	
354-359	" - Elevated Columns	58,564	
360-366	Relocation of City Owned Utilities - Water Mains	19,957	
367-380	Relocation of City Owned Utilities - Sewers	136,605	
381-382	Relocation of City Owned Utilities - Siphons	6,720	
383	Relocation of City Owned Utilities - M.T.A. High Tension Duct	308	4,860,698

	A. ALTERNATE ROUTE		
247-260	Rapid Transit Construction - Subway	4,160,240	
261-277	Rapid Transit Construction - Dudley St. Station	1,469,393	
278-283	Underpinning - Buildings	345,340	
284-290	" - Elevated Columns	184,755	
291-295	" - Dudley St. Station	89,621	
296-301	Relocation of City Owned Utilities - Water Mains	8,818	
302-314	Relocation of City Owned Utilities - Sewers	45,375	
315	Relocation of City Owned Utilities - Siphons	2,560	
316-317	Relocation of City Owned Utilities - M.T.A. High Tension Duct	688	
318	Maintenance of Traffic	24,000	6,330,790
	B. ALTERNATE ROUTE		
315-321	Demolition of Buildings at Dudley St. Station	$ 60,491	
322-333	Rapid Transit Construction - Subway	2,901,509	
334-347	Rapid Transit Construction - Dudley St. Station	1,659,194	
348-353	Underpinning - Buildings	17,350	
354-359	" - Elevated Columns		
360-366	Relocation of City Owned Utilities - Water Mains	19,957	
367-380	Relocation of City Owned Utilities - Sewers	136,605	
381-382	Relocation of City Owned Utilities - Siphons	6,720	
383	Relocation at City Owned Utilities - M.T.A. High Tension Duct	548	4,860,695

SUMMARY - LEGISLATIVE ROUTE

I. Including Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
69-94	Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks	1,963,318
247-314	Legislative Route - Lenox St. to St. James St.	6,330,790
484-486	Track Work, Power, Signals & Lighting	3,222,150
		27,089,898
	Contingencies - 10%	2,708,990
		29,798,888
	Engineering & Administration - 10%	2,979,889
		32,778,777
487	Land Damages	1,202,170
		33,980,947
	Interest During Construction	987,000
	Total	$34,967,947
	Rounded Total	$35,000,000

II. Including Shield Driven Tunnel Alternate Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
95-115	Shield Driven Tunnel Alternate Under N. Y., N. H. & H. & B. & A. R. R. Tracks	2,719,635
247-314	Legislative Route - Lenox St. to St. James St.	6,330,790
484-486	Track Work, Power, Signals & Lighting	3,222,150
		27,846,215
	Contingencies - 10%	2,784,622
		30,630,837
	Engineering & Administration - 10%	3,063,084
		33,693,921
487	Land Damages	1,202,170
		34,896,091
	Interest During Construction	1,013,000
	Total	$35,909,091
	Rounded Total	$36,000,000

SUMMARY - LEGISLATIVE ROUTE

I. Including Open Cut Method Under N. Y., N. H. & H., B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
69-94	Open Cut Method Under N. Y., N. H. & H., B. & A. R. R. Tracks	1,963,318
247-314	Legislative Route - Lenox St. to St. James St.	6,330,790
484-486	Track Work, Power, Signals & Lighting	3,222,150
		27,089,898
	Contingencies - 10%	2,708,990
		29,798,888
	Engineering & Administration - 10%	2,979,889
		32,778,777
487	Land Damages	1,202,170
		33,980,947
	Interest During Construction	987,000
	Total	$34,967,947
	Rounded Total	$35,000,000

II. Including Shasta Driven Tunnel Alternate Under N. Y., N. H. & H., B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
69-115	Shasta Driven Tunnel Alternate Under N. Y., N. H. & H., B. & A. R. R. Tracks	2,719,635
247-314	Legislative Route - Lenox St. to St. James St.	6,330,790
484-486	Track Work, Power, Signals & Lighting	3,222,150
		27,846,215
	Contingencies - 10%	2,784,622
		30,630,837
	Engineering & Administration - 10%	3,063,091
		33,693,921
487	Land Damages	1,202,170
		34,896,091
	Interest During Construction	1,013,000
	Total	$35,909,091
	Rounded Total	$36,000,000

SUMMARY - ALTERNATE ROUTE

I. Including Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
69-94	Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks	1,963,318
315-383	Alternate Route - Lenox St. to St. James St.	4,860,698
488-490	Track Work, Power, Signals & Lighting	3,153,480
		25,551,136
	Contingencies - 10%	2,555,114
		28,106,250
	Engineering & Administration -10%	2,810,625
		30,916,875
491	Land Damages	1,262,420
		32,179,295
	Interest During Construction	935,000
	Total	$33,114,295
	Rounded Total	$33,200,000

II. Including Shield Driven Tunnel Alternate Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-246, 384-483		$15,573,640
95-115	Shield Driven Tunnel Alternate Under N. Y., N. H. & H. & B. & A. R. R. Tracks	2,719,635
315-383	Alternate Route - Lenox St. to St. James St.	4,860,698
488-490	Track Work, Power, Signals & Lighting	3,153,480
		26,307,453
	Contingencies - 10%	2,630,745
		28,938,198
	Engineering & Administration - 10%	2,893,820
		31,832,018
491	Land Damages	1,262,420
		33,094,438
	Interest During Construction	961,000
	Total	$34,055,438
	Rounded Total	$34,100,000

SUMMARY - ALTERNATE ROUTE

I. Including Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-265, 324-461		$16,371,840
69-94	Open Cut Method Under N. Y., N. H. & H. & B. & A. R. R. Tracks	1,963,318
114-181	Alternate Route - Leave St. 10 50, Intersect St.	4,442,640
462-490	Track Work, Rivers, Signals & Lighting	2,121,490
		25,351,150
	Contingencies - 10%	2,535,114
		28,106,250
	Engineering & Administration - 10%	2,810,625
		30,916,875
491	Land Damages	1,262,420
		32,179,295
	Interest During Construction	935,000
	Total	33,114,295
	Rounded Total	$33,200,000

II. Including Shield Tunnel Under Harlem River

N. H. & H. & B. & A. R. R. Tracks

Nos.	Item	Amount
1-68, 116-146, 324-461		$16,371,840
95-115	Shield Tunnel Alternate Under	
	N. Y., N. H. & H. & B. & A. R. R. Tracks	4,744,640
345-387	Alternate Route - Leave St. 10 50, Intersect St.	4,442,640
462-490	Track Work, Rivers, Signals & Lighting	2,121,490
		27,680,470
	Contingencies - 10%	2,768,047
		30,448,517
	Engineering & Administration - 10%	3,044,852
		33,493,369
491	Land Damages	1,262,420
		34,755,789
	Interest During Construction	965,000
	Total	35,720,789
	Rounded Total	$35,800,000

We have endeavored to prepare a complete preliminary design of the proposed new Washington Street rapid transit facility. The work covered by this report is in fulfillment of the requirements of the "Preliminary Phase" but it is in greater detail than might be required by the terms of the contract.

While some difficult problems have been encountered, we feel that practical and economical solutions have been reached in all cases.

We trust that our report, plans and estimate will meet with your approval but we will make such changes as may be deemed desirable after you have had an opportunity to study these documents.

Respectfully submitted

PRAEGER-MAGUIRE
AND
SINGSTAD & BAILLIE

By E. Praeger

Charles O. Maguire

O. K. Singstad

David G. Baillie Jr.

We have endeavored to prepare a complete preliminary design of the proposed new Washington Street rapid transit facility. The work covered by this report is in fulfillment of the requirements of the "Preliminary Phase" but it is to be clearly understood that this work is not to be construed as the detail plans required by the terms of the contract.

While some difficult problems have been encountered, we feel that practical and economical solutions have been reached in all cases.

We trust that our report, plans and estimate will meet with your approval but we will make such changes as may be deemed desirable after you have had an opportunity to study these documents.

Respectfully submitted

PRAEGER-MAGUIRE
AND
SEMBRATZKI-BAILLIE

By _____

_____

_____

_____

APPENDIX

Preliminary Drawings

Alternate Drawings

Supplementary Drawings

M. T. A. Drawings

APPENDIX

Alternate Drawings

M. I. A. Drawings

PRELIMINARY DRAWINGS

Plan No.	Title
1.	Filing Plan - Legislative Route
2.	Key Plan " "
3.	Alignment-Station 2 + 30 To 15 + 00
4.	" " 15 + 00 " 36 + 47
5.	" " 36 + 47 " 58 + 47
6.	" " 58 + 47 " 78 + 35
7.	" " 78 + 35 " 92 + 56 Legislative Route
8.	" " 92 + 56 " 106 + 62 " "
9.	" " 106 + 62 " 116 + 47 " "
10.	" " 115 + 00 " 127 + 00
11.	" " 127 + 00 " 140 + 00
12.	" " 140 + 00 " 151 + 70
13.	" " 151 + 70 " 155 + 01
14.	" " 155 + 01 " 158 + 72
15.	" " 158 + 72 " 162 + 85
16.	" " 162 + 85 " 165 + 45
17.	" " 165 + 45 " 168 + 95
18.	" " 168 + 95 " 172 + 43
19.	" " 172 + 43 " 176 + 03
20.	" " 176 + 03 " 179 + 64
21.	" " 179 + 64 " 183 + 36
22.	" " 183 + 36 " 187 + 17
23.	" " 187 + 17 " 190 + 96
24.	" " 190 + 96 " 194 + 55
25.	" " 194 + 55 " 198 + 29
26.	" " 198 + 29 " 201 + 87
27.	" " 201 + 87 " 205 + 47
28.	" " 205 + 47 " 209 + 18
29.	" " 209 + 18 " 212 + 88
30.	" " 212 + 88 " 216 + 86
31.	" " 216 + 86 " 221 + 06
32.	" " 221 + 06 " 224 + 67
33.	" " 224 + 67 " 228 + 69
34.	Profile-Station 2 + 30 " 15 + 30
35.	" " 15 + 30 " 36 + 00
36.	" " 36 + 00 " 57 + 00
37.	" " 57 + 00 " 78 + 00
38.	" " 78 + 00 " 99 + 00 Legislative Route
39.	" " 99 + 00 " 120 +00 " "
40.	" " 120 + 00 " 141 +00
41.	" " 141 + 00 " 151 +70
42.	" " 151 + 70 " 161 +61
43.	" " 161 + 61 " 175 +58
44.	" " 175 + 58 " 190 + 00
45.	" " 190 + 00 " 197 + 15
46.	" " 197 + 15 " 206 + 43

1.	Filing Plan - Legislative Route					
2.	Key Plan	"		"		
3.	Alignment-Station	2	+ 30	To	15	+ 00
4.	"	"	15	+ 00	"	36 + 47
5.	"	"	36	+ 47	"	58 + 47
6.	"	"	58	+ 47	"	78 + 35
7.	"	"	78	+ 35	"	92 + 56
8.	"	"	92	+ 56	"	106 + 62
9.	"	"	106	+ 62	"	116 + 47
10.	"	"	115	+ 00	"	127 + 00
11.	"	"	127	+ 00	"	140 + 00
12.	"	"	140	+ 00	"	151 + 70
13.	"	"	151	+ 70	"	155 + 01
14.	"	"	155	+ 01	"	158 + 72
15.	"	"	158	+ 72	"	162 + 85
16.	"	"	162	+ 85	"	165 + 45
17.	"	"	165	+ 45	"	168 + 95
18.	"	"	168	+ 95	"	172 + 43
19.	"	"	172	+ 43	"	176 + 03
20.	"	"	176	+ 03	"	179 + 64
21.	"	"	179	+ 64	"	183 + 36
22.	"	"	183	+ 36	"	187 + 17
23.	"	"	187	+ 17	"	190 + 96
24.	"	"	190	+ 96	"	194 + 55
25.	"	"	194	+ 55	"	198 + 29
26.	"	"	198	+ 29	"	201 + 87
27.	"	"	201	+ 87	"	205 + 47
28.	"	"	205	+ 47	"	209 + 18
29.	"	"	209	+ 18	"	212 + 88
30.	"	"	212	+ 88	"	216 + 86
31.	"	"	216	+ 86	"	221 + 06
32.	"	"	221	+ 06	"	224 + 67
33.	"	"	224	+ 67	"	228 + 69
34.	Profile-Station	2	+ 30	"	15	+ 30
35.	"	"	15	+ 30	"	36 + 00
36.	"	"	36	+ 00	"	57 + 00
37.	"	"	57	+ 00	"	78 + 00
38.	"	"	78	+ 00	"	99 + 00
39.	"	"	99	+ 00	"	120 +00
40.	"	"	120	+ 00	"	141 +00
41.	"	"	141	+ 00	"	151 +70
42.	"	"	151	+ 70	"	161 +61
43.	"	"	161	+ 61	"	175 +58
44.	"	"	175	+ 58	"	190 + 00
45.	"	"	190	+ 00	"	197 + 15
46.	"	"	197	+ 15	"	209 + 42

Legislative Route
" "
Legislative Route
" "

PRELIMINARY DRAWINGS

Plan No.	Title
47.	Profile-Station 206 + 43 To 213 + 91
48.	" " 213 + 91 " 218 + 02
49.	" " 218 + 02 " 223 + 17
50.	" " 223 + 17 " 228 + 69
51.	Boylston St. Connection-Framing Plan
52.	" " " -Construction Operations
53.	" " " -Section A-A
54.	" " " - " B-B
55.	" " " - " C-C
56.	Ventilation-Plan
57.	" "
58.	" -Details
59.	Typical Concrete Sections for Open Cut
60.	Underpinning NY., N.H. & H. & B.&A.R.R. Tracks
61.	Tunnel Under N.Y., N.H. & H. & B. & A.R.R. Tracks - Alignment & Profile
62.	" " " " " " "
63.	" " " " " " "
64.	" " " " " -Cast Iron Ring
65.	" " " " " " " "
66.	" " " " " -Sump & Pump Room
67.	Typical Section Under Buildings
68.	Underpinning Buildings Over Subway
69.	Typical Concrete Section For Crossovers
70.	Typical Section At Stations
71.	Union Park St. Station - Scheme A - Plans
72.	" " " " " " - Section A-A
73.	" " " " " " " B-B
74.	" " " " " " - Architectural
75.	Massachusetts Ave. Station - Scheme A-Plans
76.	" " " - " " Section A-A
77.	" " " " " " B-B
78.	" " " " " Architectural
79.	" " " " " Wall Details
80.	Underpinning Elevated Columns on Washington St.
81.	" " " -Legislative Route
82.	" " " -Station 115+00 To 127+00
83.	" " " - " 127+00 " 140+00
84.	Dudley St. Station-Legislative Route-Scheme A-Stage 1
85.	" " " " " - " " " 2
86.	" " " " " " " -Section A-A
87.	" " " " " " " " B-B
88.	" " " " " " " -Invert Framing Plan
89.	" " " " " " " -Roof " "
90.	" " " " " " " -Mezz.

Plan No.	Title
47.	Profile-Station 206 + 43 To 213 + 91
49.	" " 218 + 02 " 223 + 17
50.	" " 223 + 17 " 228 + 69
51.	Boylston St. Connection-Framing Plan
52.	" " " -Construction Operations
53.	" " " -Section A-A
54.	" " " - " B-B
55.	" " " - " C-C
58.	" -Details
59.	Typical Concrete Sections for Open Cut
60.	Underpinning NY., N.H. & H. & B. & A. R. R. Tracks
61.	Tunnel Under N. Y., N.H. & H. & B. & A. R. R. Tracks - Alignment & Profile
62.	" " " " " " "
63.	" " " " " " "
64.	" " " " -Cast Iron Ring
65.	" " " " " " "
66.	" " " " -Sump & Pump Room
67.	Typical Section Under Buildings
68.	Underpinning Buildings Over Subway
69.	Typical Concrete Section For Crossovers
70.	Typical Section At Stations
72.	" " " " " - Section A-A
73.	" " " " " " B-B
74.	" " " " " - Architectural
75.	Massachusetts Ave. Station - Scheme A-Plans
76.	" " " - " Section A-A
77.	" " " " " " B-B
78.	" " " " " Architectural
79.	" " " " " Wall Details
81.	" " " -Legislative Route
82.	" " " -Station 115+00 To 127+00
87.	" " " " " -Section A-A
88.	" " " " " " B-B
89.	" " " " " -Roof
90.	" " " " " -Mezz.

PRELIMINARY DRAWINGS

Plan No.	Title
91.	Dudley St. Station-Legislative Route - Underpinning Elevated Columns
92.	Sections of Incline
93.	Columbus Ave. Station-Schemes A & B -Plan
94.	" " " " A & A1-Sections
95.	" " " " " " "
96.	" " " " A & B "
97.	Abutment & Wing Walls At Station 161+61
98.	Precast Beam Method for Stony Brook Conduit
99.	Liner Plate " " " " "
100.	Graphical Solution For Loads On Stony Brook Conduit
101.	" Investigation Of " " "
102.	Section Of Embankment -Along N. Y., N. H. & H. R. R.
103.	" " " " " " "
104.	" " " " " " "
105.	" " " " " " "
106.	" " " " " " "
107.	" " " " " " "
108.	" " " " " " "
109.	" " " " " " "
110.	" " " " " " "
111.	" " " " " " "
112.	" " " " " " "
113.	" " " " " " "
114.	" " " " " " "
115.	" " " " " " "
116.	" " " " " " "
117.	" " " " " " "
118.	" " " " " " "
119.	" " " " " " "
120.	" " " " " " "
121.	" " " " " " "
122.	" " " " " " "
123.	" " " " " " "
124.	Atherton St. Bridge
125.	" " " Abutment
126.	Pedestrian Underpass Extension-Station 193+28
127.	Boylston St. Bridge
128.	" " " Abutment
129.	Green St. Bridge
130.	" " " Abutment
131.	" " Station-Plans
132.	" " " "
133.	" " " -Sections
134.	" " " "
135.	" " " "
136.	" " " "

Plan No.	Title
91.	Underpinning Elevated Columns
92.	Sections of Incline
94.	" " A & A1-Sections
95.	" " "
96.	" " A & B "
97.	Abutment & Wing Walls At Station 161+61
98.	Precast Beam Method for Stony Brook Conduit
99.	Liner Plate " " " " "
100.	
101.	" Investigation Of
102.	Section Of Embankment -Along N. Y., N. H. & H. R. R.
103.	" " " " " " "
104.	" " " " " " "
105.	" " " " " " "
106.	" " " " " " "
107.	" " " " " " "
108.	" " " " " " "
109.	" " " " " " "
110.	
111.	
112.	" " " " " " "
113.	" " " " " " "
114.	" " " " " " "
115.	" " " " " " "
116.	" " " " " " "
117.	
118.	" " " " " " "
119.	" " " " " " "
120.	" " " " " " "
121.	" " " " " " "
122.	
123.	
124.	
125.	" " " Abutment
126.	Pedestrian Underpass Extension-Stations
127.	Boylston St. Bridge
128.	" " " Abutment
129.	Green St. Bridge
130.	" " " Abutment
131.	
132.	" " "
133.	" " " -Sections
134.	
135.	" " "

PRELIMINARY DRAWINGS

Plan No.	Title
137.	Williams St. Abutment
138.	Elevated Bents
139.	Brookley Road Connection-Plan
140.	" " " -Construction Operations
141.	Filing Plan -Alternate Route
142.	Key Plan- " "
143.	Alignment-Station 78+35 To 94+00 Alternate Route
144.	" " 94+00 " 115+00 " "
145.	Profile- " 78+00 " 99+00 " "
146.	" " 99+00 " 120+00 " "
147.	Underpinning Elevated Columns " "
148.	Dudley St. Station-Alternate Route-Schemes A & A1-Plan
149.	" " " " " Scheme A-Invert & Roof Framing -Plan
150.	" " " " " " A-Passageway Roof Framing-Plan
151.	" " " " " " "-Section A-A

ALTERNATE DRAWINGS

Plan No.	Title
201.	Ventilation - Plan
202.	" "
203.	Typical Bent for Open Cut Above Ground Water Level
204.	" " " " " Below " " "
205.	Underpinning N. Y., N. H. & H. & B. & A. R. R. Tracks - Alternate 1
206.	" " " " " " " " " " " - Alternate 2
207.	" " " " " " " " " " " - Alternate 2
208.	Typical Section at Stations
209.	Union Park St. Station - Scheme A1 - Plans
210.	" " " " " " Section A-A
211.	" " " " " " " B-B
212.	" " " " " B - Plans
213.	" " " " " " Section A-A
214.	" " " " " " " B-B
215.	" " " " " B1 - Plans
216.	" " " " " " Section A-A
217.	" " " " " " " B-B
218.	Massachusetts Ave. Station - Scheme A1 - Plans
219.	" " " " " Section A-A
220.	" " " " " " B-B
221.	Dudley St. Sta. - Legislative Route - Schemes B & BI - Lower Level
222.	" " " " " " " " - Upper Level
223.	" " " " " " " " East Loop
224.	" " " " " " " & - Framing Plan
225.	" " " " " " " " - " "
226.	" " " " " " " " - " "
227.	" " " " " " " " - Const. Procd.
228.	" " " " " " " " - Reroute Transp.
229.	" " " " " " BI - Framing Plans
230.	" " " " " " " - Section A-A
231.	" " " " " " " " B-B
232.	" " " " " " C & CI - Plan
233.	" " " " " " C - Framing Plans
234.	" " " " " " " " "
235.	" " " " " " " " "
236.	" " " " " " " Section A-A
237.	" " " " " " " " B-B
238.	" " " " " " C & CI - Const. Procd.
239.	" " " " " " " " Reroute Transp.
240.	" " " " " " " " Architectural
241.	" " " " " " CI - Framing Plan
242.	" " " " " " " " "
243.	" " " " " " " " "
244.	" " " " " " " Section A-A
245.	" " " " " " " " B-B
246.	Columbus Ave. Station - Scheme B & BI - Sections

Plate No.	Title
203.	Typical Bent for Open Cut Above Ground Water Level
204.	" " " " " " Below " " "
205.	Underpinning Pl., Pl. & Sec. Typical Alternate 1
206.	" " " " " " " " " " " " Alternate 2
207.	" " " " " " " " " " " " Alternate 3
208.	Typical Section at Stations
209.	Union Park St. Station - Scheme A1 - Plans
210.	" " " " " " Section A-A
211.	" " " " " " " B-B
212.	" " " " B - Plans
213.	" " " " " Section A-A
214.	" " " " " " B-B
215.	" " " " B1 - Plans
216.	" " " " " Section A-A
217.	" " " " " " B-B
218.	Massachusetts Ave. Station - Scheme A1 - Plans
219.	" " " " " Section A-A
220.	" " " " " " B-B
221.	Dudley Sq. Sta. - Tentative Scale-Sections 7&8 Lower Level
222.	" " " " " " " " - Upper Level
223.	" " " " " " " " East Loop
224.	" " " " " " " & - Framing Plan
225.	" " " " " " " " " "
226.	" " " " " " " " " "
227.	" " " " " " " " - Const. Procd.
228.	" " " " " " " " - Reroute Transp.
229.	" " " " " " BI - Framing Plans
230.	" " " " " " " - Section A-A
231.	" " " " " " " " B-B
232.	" " " " " C & CI - Plan
233.	" " " " " C - Framing Plans
234.	" " " " " " " "
235.	" " " " " " " "
236.	" " " " " " Section A-A
237.	" " " " " " " B-B
238.	" " " " " C & CI - Const. Procd.
239.	" " " " " " " Reroute Transp.
240.	" " " " " " " Architectural
241.	" " " " " " CI-Framing Plan
242.	" " " " " " " "
243.	" " " " " " " "
244.	" " " " " " Section A-A
245.	" " " " " " " B-B
246.	Columbus Ave. Station - Scheme B & BI - Sections

ALTERNATE DRAWINGS

Plan No.	Title
247.	Columbus Ave. Station - Scheme B & BI - Sections
248.	Concrete Liner Method For Stony Brook Conduit
249.	Steel Rib & Precast Reinf. Conc. Slab for Stony Brook Conduit
250.	Atherton St. Bridge Abutment
251.	Dudley St. Sta. - Alternate Route - Scheme A1-Framing Plan
252.	" " " " " - " " " "
253.	" " " " " " " Section A-A
254.	" " " " " " B & B 1 - Plan
255.	" " " " " " B-Framing Plans
256.	" " " " " " " " Plan
257.	" " " " " " " Section A-A
258.	" " " " " " " Section B-B
259.	" " " " " " B1-Framing Plan
260.	" " " " " " " " Plans
261.	" " " " " " " Section A-A
262.	" " " " " " " " B-B

Note:

The above listed "Alternate Drawings" show details of studies which were made at the locations indicated. These drawings have been superseded by the "Preliminary Drawings" previously listed but they are submitted with this report for information and filing.

ALTERNATE DRAWINGS

Plan No.	Title
247.	Columbus Ave. Station - Schema A & B1 - Revised
248.	Concrete Lined Method For Stony Brook Conduit
249.	Steel Rib & Precast Panel Const. Type with Stony Brook Conduit
250.	Arlington St. Bridge Abutments
251.	Dudley Sq. Sta. - Alternate Plants - Schema A1-Framing Plan
252.	" " " " " " " "
253.	" " " " " " " Section A-A
254.	" " " " " " " "
255.	" " " " " " B-Framing Plans
256.	" " " " " " " Plan
257.	" " " " " " " Section A-A
258.	" " " " " " " Section B-B
259.	" " " " " " " "
260.	" " " " " " " Plans
261.	" " " " " " " Section A-A
262.	" " " " " " " B-B

Notes:

The above listed "Alternate Drawings" show details of studies which were made at the locations indicated. These drawings have been superseded by the "Preliminary Drawings" previously listed but they are submitted with this report for information and filing.

SUPPLEMENTARY DRAWINGS

	Description	File	Plan No.
BORINGS	- Contract Plans showing location of Borings and Wells	BOR	1-4
	Record Plans showing detailed... locations of Borings and Wells	BOR	5-10
	Profile of Earth Strata at Borings	BOR	11-14
ALIGNMENT PLAN	- General Plan and Profile at Scale 1"=100' Horizontal and 1"=20' Vertical (Roll Plan).....	AL	1
SUBSURFACE STRUCTURES	- Record Drawings of Sub-Surface Structures (Sewers, Water, Gas, Electricity, Etc.....	SS	0-33
RELOCATION OF SEWERS & WATER	- Proposed Relocation of Sewer and Water Lines.....	R	1-33
STONY BROOK CULVERT	- Record Plan and Profile of Stony Brook Culvert.....	SB	1-8
SECTIONS OF N. H. R. R.	- Right of Way sections of proposed Embankment along New Haven R. R. right of way	SB	9-11
REAL ESTATE APPRAISAL MAP	- Map of Real Estate showing Property affected by proposed subway.....	RE "A",	1-34 & 15B TO 18B
BUILDING PLANS	- Nos. 915-919 Washington St.	BR	1
	" 923-925 Washington St.	(Architect's Drawings	
	" 929 Washington St.	BR	2
	" 941-945 Washington St.	BR	3
	" 973-977 Washington St. (50 Castle St.)	BR	4
	" 16-16A Mayo St.	BR	5
	" 985-989 Washington St.	BR	6
	" 991-999 Washington St.	BR	7
	" 1001-1009 Washington St.	BR	8
	" 6-12 Cobb Street	BR	9

SUPPLEMENTARY DRAWINGS

	Description	File	Plan No.
BORINGS	- Contract Plans showing location of Borings and Wells	BOR	1-4
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	Profile of Earth Strata at Borings	BOR	11-14
ALIGNMENT PLAN	- General Plan and Profile at Scale 1"=100' Horizontal and 1"=20' Vertical (Roll Plan).....	AL	1
SUBSURFACE STRUCTURES	- Record Drawings of Sub-Surface Structures (Sewers, Water, Gas, Electricity, Etc.....	SS	0-33
RELOCATION OF SEWERS & WATER	- Proposed Relocation of Sewer and Water Lines.....	R	1-33
STONY BROOK CULVERT	- Record Plan and Profile of Stony Brook Culvert.....	SB	1-8
SECTIONS OF N. H. R. R.	- Right of Way sections of proposed Embankment along New Haven R. R. right of way	SB	9-11
REAL ESTATE	- Map of Real Estate showing subway.....	RE "A",	1-34 & 1SB TO 18B
BUILDING PLANS - Nos.	923-925 Washington St. (Architect's Drawings		
"	929 Washington St.	BR	2
"	941-945 Washington St.	BR	3
	(50 Castle St.)	BR	4
"	16-16A Mayo St.	BR	5
"	985-989 Washington St.	BR	6
"	991-999 Washington St.	BR	7
"	1001-1009 Washington St.	BR	8
"	6-12 Cobb Street	BR	9

SUPPLEMENTARY DRAWINGS

	Description	File	Plan No.
BUILDING PLANS	- Nos. 15-19 Lucas Street	BR	10
	" 10 Compton Street	BR	11A
	" 11-11 1/2 Cobb Street	BR	11
	" 11-13 Compton Street	BR	12
	" 15-17 Compton Street	BR	13
	" 12-12A Compton Street	BR	14
	" 14 Compton Street	BR	15
	" 11-17 Waterford Street	BR	16
	" 19-21 Waterford Street	BR	17 & 17A
	" 1083-1085 Washington (16-18 Waterford)	BR	18
	" 1093-1095 Washington Street	(Architect's Plans)	
	" 10-14 Garland Street	BR	19
	" 76-74A Dover Street	BR	20
	" 2101-2115 Washington Street	BR	21
	" 2121-2131 Washington Street	BR	22
	" 2148-2154 Washington Street	BR	23
	" 2164-2168 Washington Street	BR	24
	" 2172 Washington Street	BR	25
	" 2-6 Warren Street	BR	26
	" 18-20 Warren Street	BR	27
	" 15-19 Warren Street	BR	28
	Dudley Street Station (MTA PLANS) Nos. 112-116 Dudley Street	(Architect's Plans)	
	44-50 Roxbury Street	BR	29
	Underpass Minton Street	BR	30
	No. 80 Dudley Street	(Architect's Plans)	
	No. 4 Kenilworth Street	(Architect's Plans)	

NOTE:

In the case of buildings not listed above but shown on the real estate appraisal maps photographs are on file in the Boston office of Praeger-Maguire and Singstad & Baillie.

Additional Plans Available at office of Praeger-Maguire and Singstad & Baillie but not included in report.

Map of Survey from Bartlett Street to Forest Hills - map prepared by New England Survey service of Survey along the route of the proposed subway..... SUR 1-4

Map of Survey from Bartlett to Lenox Streets-map prepared by Praeger-Maguire & Singstad & Baillie of survey along the route of the proposed subway. Survey made by M.T.A. and P.M. & S&B. SUR 5

" 1083-1085 Washington (16-18 Waterford)	BR	18
" 1093-1095 Washington Street (Architect's Plans)		
" 10-14 Garland Street	BR	19
" 76-74A Dover Street	BR	20
" 2101-2115 Washington Street	BR	21
" 2121-2131 Washington Street	BR	22
" 2148-2154 Washington Street	BR	23
" 2164-2168 Washington Street	BR	24
" 2172 Washington Street	BR	25
" 2-6 Warren Street	BR	26
" 18-20 Warren Street	BR	27
" 15-19 Warren Street	BR	28
Dudley Street Station		
14-50 Roxbury Street	BR	29
(Architect's Plans)		

In the case of buildings not listed above but shown
on file in the Boston office of Praeger-Maguire and
Singstad & Baillie.

Singstad & Baillie but not included in report.

Map of Survey from Bartlett Street to Forest Hills - map prepared

Map of Survey from Bartlett to Lenox Streets-map prepared by

SUPPLEMENTARY DRAWINGS

Description	File	Plan No.
- Map of Survey from Ball to West Springfield to Hanson Streets Map prepared by M. T. A.	SUR	6
- Map of Survey from West Springfield to Hanson Streets, Map prepared by M. T. A.	SUR	7
- Map of survey from Dover to LaGrange Streets along route of proposed subway. Map prepared by P. -M and S. &B. From survey by M. T. A. and P. -M. and S. &B.	SUR	8
- Section of Stony Brook Culvert (Scale 1/4 "=1 ft.).....	SB	12
Highway Department Map-Shawmut Ave. from Sterling Street to Dover Street (City of Boston)		

SUPPLEMENTARY DRAWINGS

Description	File	Plan No.
- Map of Survey from Ball to West Springfield to Hanson Streets Map prepared by M.T.A.	SUR	6
- Map of Survey from West Springfield to Hanson Streets, Map prepared by M.T.A.	SUR	7
- Map of survey from Dover to LaGrange Streets along route of proposed subway. Map prepared by P.-M and S.&B. From survey by M. T. A. and P.-M. and S.&B.	SUR	8
(Scale 1\4 "=1 ft.)	SB	12

Highway Department Map-Shawmut Ave.
from Blanding Street to Dover Street
(City of Boston)

M. T. A. Drawings

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T-a-14642	" "	Sheet 3 of 14
T-a-14643	" "	Sheet 4 of 14
T-a-14644	" "	Sheet 5 of 14
T-a-14645	" "	Sheet 6 of 14
T-a-14646	" "	Sheet 6 A
T-a-14647	" "	Sheet 7 of 14
T-a-14648	" "	Sheet 7 A
T-a-14649	" "	Sheet 8 of 14
T-a-14650	" "	Sheet 8 A
T-a-14651	" "	Sheet 9 of 14
T-a-14652	" "	Sheet 10 of 14
T-a-14653	" "	Sheet 11 of 14
T-a-14654	" "	Sheet 12 of 14
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T-a-14740	Signals & Lighting	Sheet 1 of 14
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T-a-14751	" "	Sheet 9 of 14
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T-a-14760	Power System	Sheet 1 of 14
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T-a-14767	" "	Sheet 7 of 14
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T-a-14769	" "	Sheet 8 of 14

M. T. A. Drawings

Plan No.	Title	
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T-a-14643	" "	Sheet 4 of 14
T-a-14644	" "	Sheet 5 of 14
T-a-14645	" "	Sheet 6 of 14
T-a-14646	" "	Sheet 6 A
T-a-14647	" "	Sheet 7 of 14
T-a-14648	" "	Sheet 7 A
T-a-14649	" "	Sheet 8 of 14
T-a-14650	" "	Sheet 8 A
T-a-14651	" "	Sheet 9 of 14
T-a-14652	" "	Sheet 10 of 14
T-a-14653	" "	Sheet 11 of 14
T-a-14654	" "	Sheet 12 of 14
T-a-14655	" "	Sheet 13 of 14
T-a-14656	" "	Sheet 14 of 14
T-a-14740	Signals & Lighting	Sheet 1 of 14
T-a-14741	" "	Sheet 2 of 14
T-a-14742	" "	Sheet 3 of 14
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T-a-14746	" "	Sheet 6A
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T-a-14748	" "	Sheet 7 A
T-a-14749	" "	Sheet 8 of 14
T-a-14750	" "	Sheet 8 A
T-a-14751	" "	Sheet 9 of 14
T-a-14752	" "	Sheet 10 of 14
T-a-14753	" "	Sheet 11 of 14
T-a-14754	" "	Sheet 12 of 14
T-a-14755	" "	Sheet 13 of 14
T-a-14756	" "	Sheet 14 of 14
T-a-14760	Power System	Sheet 1 of 14
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T-a-14762	" "	Sheet 3 of 14
T-a-14763	" "	Sheet 4 of 14
T-a-14764	" "	Sheet 5 of 14
T-a-14765	" "	Sheet 6 of 14
T-a-14766	" "	Sheet 6 A
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M. T. A. Drawings

Plan No.	Title	
T-a-14770	Power System	Sheet 8 A
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T-a-14773	" "	Sheet 11 of 14
T-a-14774	" "	Sheet 12 of 14
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	Power System	Sheet 8 A
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	" "	Sheet 14 of 14

SYMBOLS

- ELEVATED SECTION
- SECTION ON FILL
- SUBWAY SECTION
- EXISTING ELEVATED
- EXISTING SUBWAY

DATE	NO	TO	BY
		ISSUES	

DATE	DESCRIPTION	BY
	REVISIONS	

METROPOLITAN TRANSIT AUTHORITY

RAPID TRANSIT IMPROVEMENTS, BOYLSTON STA. TO FOREST HILLS

KEY PLAN
LEGISLATIVE ROUTE

PRAEGER - MAGUIRE
AND
OLE SINGSTAD
ENGINEERS
294 WASHINGTON ST.
BOSTON 8, MASS.

APPROVED BY _____
AND _____

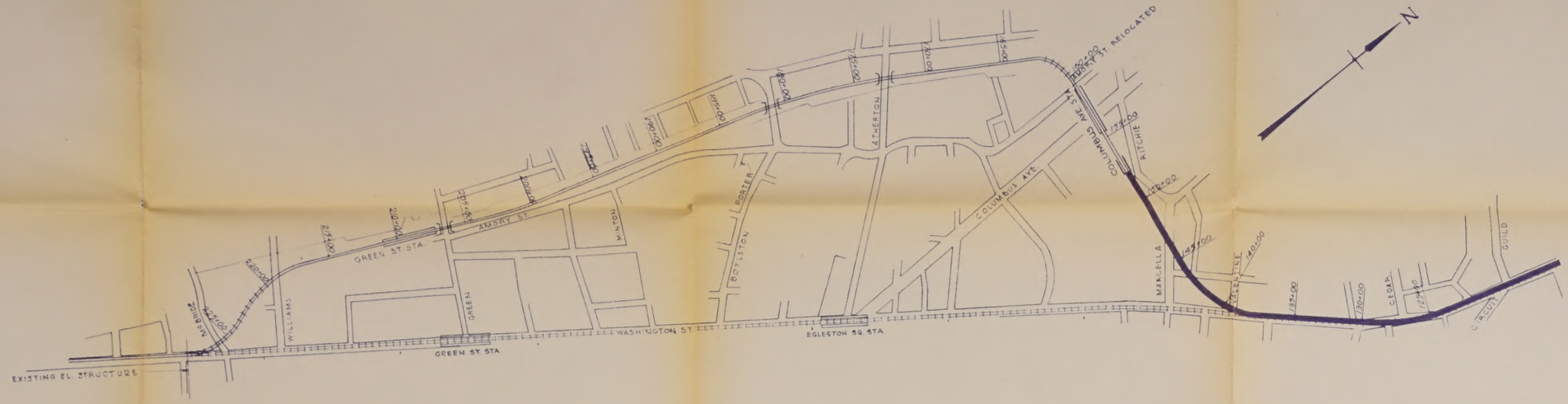
SCALE 1"=400'
DATE 4-15-52
FILE NO. 12508
PLAN NO. 2
DESIGNED BY _____
DRAWN BY A - D
CHECKED BY _____

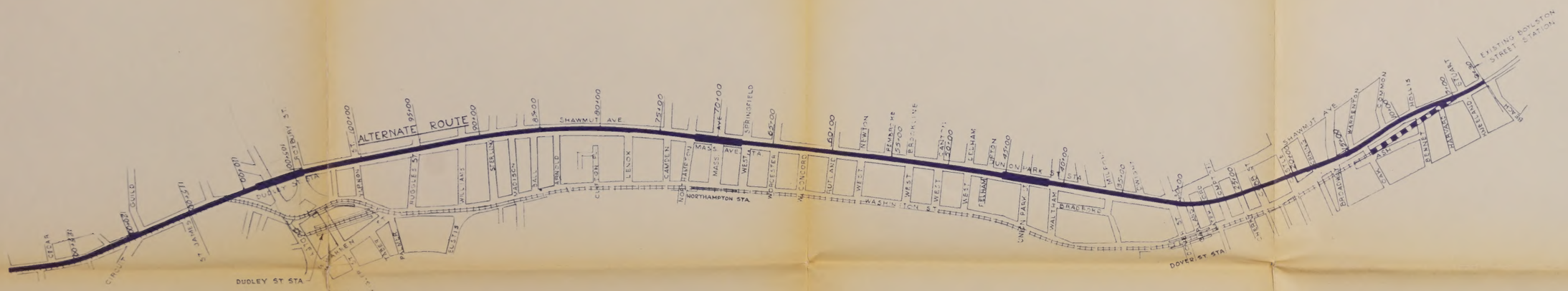
METROPOLITAN
TRANSIT
AUTHORITY

APPROVED

BY _____
SUPT OF ENGINEERING
AND MAINTENANCE

Boston Redevelopment Authority
8-11-64





SYMBOLS

- ELEVATED SECTION
- SECTION ON FILL
- SUBWAY SECTION
- EXISTING ELEVATED
- EXISTING SUBWAY

PRELIMINARY

METROPOLITAN TRANSIT AUTHORITY

RAPID TRANSIT IMPROVEMENTS, BOYLSTON STA. TO FOREST HILLS

KEY PLAN
ALTERNATE ROUTE

DATE	NO.	TO ISSUES	BY	DATE	DESCRIPTION REVISIONS	BY

PRAEGER - MAGUIRE AND OLE SINGSTAD ENGINEERS
294 WASHINGTON ST.
BOSTON 8, MASS.

APPROVED BY _____
AND _____

SCALE 1"=400'
DATE 1-15-52
FILE NO 2709
PLAN NO 4-E
DESIGNED BY _____
DRAWN BY A. J. D.
CHECKED BY _____

METROPOLITAN TRANSIT AUTHORITY
APPROVED
BY _____
SUPT. OF ENGINEERING AND MAINTENANCE

Boston Redevelopment Authority
8-1-64